

EFFECTS OF COMPUTER-ASSISTED AND TEACHER-LED
PHONOLOGICAL AWARENESS INSTRUCTION FOR
FIRST-GRADE STUDENTS AT RISK FOR
READING FAILURE

By

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Abstract of Dissertation Presented to the Graduate School
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By

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Experimental, neurophysiological, and genetic research support a phonological model of beginning reading. This model provides a conceptual framework that demonstrates how phonological processing affects reading and the importance of phonological instruction to acquiring beginning reading skills. The purpose of this study was to determine if computer-assisted instruction in phonological awareness is as effective as teacher-led instruction for first-grade children with delayed development of phonological awareness. In an experimental pretest-posttest-control group design, participants (N=64) were randomly assigned to groups receiving computer instruction, teacher instruction, or no instruction in phonological awareness. At pretest, a series of analyses of covariance (ANCOVAs) indicated no significant

differences between the three groups on measures of blending, segmentation, elision, and reading. At posttest, planned orthogonal comparisons revealed no significant differences on these measures between groups receiving computer-assisted instruction and groups receiving teacher-led instruction. The intervention groups made significantly higher pretest-to-posttest gains than the control group on the measure of segmentation. No significant differences between groups were indicated on measures of blending, elision, or nonword reading. These results were inconsistent with prior research in which groups instructed in phonological awareness have consistently demonstrated significantly higher increases in phonological and reading skills when compared to control groups receiving no phonological awareness instruction. The results of the present study may be due to (a) the effects of classroom reading instruction and (b) lack of transfer from phonological to reading skills. Classroom reading instruction that included blending skills may have been sufficient for the control group to achieve progress comparable to the intervention groups. Failure to transfer their superior skill in segmentation to reading tasks may have prevented the teacher-led group from significantly increasing reading skills relative to the control group. Implications for research include designing interventions to determine the optimal duration and intensity of instruction that facilitate transfer of phonological skills to reading. The effects of metacognitive instruction in phonological

awareness on transfer of skills should continue to be investigated.

CHAPTER I
INTRODUCTION TO THE PROBLEM

Introduction

Two decades of research provide significant support for the role that phonological awareness plays in the development of reading ability (e.g., Adams, 1990; Stanovich, 1986, 1988; Torgesen, Wagner, Simmons, & Laughon, 1990; Vellutino & Scanlon, 1987; Wagner & Torgesen, 1987; Wagner, Torgesen, & Rashotte, 1994). Correlational studies show phonological awareness is positively related to reading ability; that is, good readers have higher levels of phonological awareness than poor readers (Bradley & Bryant, 1985; Calfee, Lindamood, & Lindamood, 1973; Fox & Routh, 1975, 1980; Rosner & Simon, 1971; Turner & Nesdale, 1985; Vellutino & Scanlon, 1987). Additionally, longitudinal studies demonstrate that phonological awareness in young children predicts reading ability (Blachman, 1984; Bradley & Bryant, 1985; MacLean, Bryant, & Bradley, 1987; Mann, 1984; Mann & Liberman, 1984). Moreover, a substantial number of studies have shown that phonological awareness skills can be taught and that increases in children's phonological awareness skills have been consistently accompanied by improvement in reading ability (Bradley & Bryant, 1985; Byrne & Fielding-Barnsley, 1991; Iverson & Tunmer, 1993; Lundberg, Frost, & Petersen,

1988; McGuinness, McGuinness, & Donohue, 1995; Williams, 1980).

Neurobiological findings support the existence of a causal link between phonological awareness and reading. Brain scans show tissue anomalies and differences in the locus of metabolic activation during reading in normal readers and persons with dyslexia (Galaburda & Geschwind, 1985; Lyon, 1995). Brain scan research is augmented by genetic studies that provide a genetic explanation for structural abnormalities of the brain (Cardon et al., 1994). Genetic studies of persons with dyslexia suggest that phonological awareness may be influenced by heredity (Lyon, 1995).

Taken together, experimental, intervention, neurophysiological, and genetic findings support a phonological model of beginning reading (Adams, 1990). This model provides a conceptual framework that demonstrates how phonological processing affects reading and suggests the importance of phonological instruction to acquiring beginning reading skills.

Because of the established relationship between phonological awareness and beginning reading achievement, instruction in phonological awareness is critical in the primary grades. To design and measure effective instruction, it is necessary to examine the construct of phonological awareness (McBride-Chang, 1995; Yopp, 1988). Areas of

research suggesting that phonological awareness is not a unitary construct but a multifaceted group of related skills are (a) developmental evidence, (b) construct validation evidence, and (c) training study evidence.

Developmental evidence indicates that younger children have fewer phonological skills than older children. Tasks are acquired in a predictable sequence based on the complexity of the phonological task to be performed and the level of the language component to be manipulated (Smith, 1995). Correlational studies provide further evidence of the developmental nature of phonological awareness. These studies show poor readers have fewer phonological skills than good readers, regardless of age (Stanovich, Nathan, & Zolman, 1988).

Construct validation evidence (McBride-Chang, 1995; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993; Yopp, 1988) suggests that more than one phonological skill may significantly affect reading performance. Two distinct but correlated abilities composing phonological awareness have been identified: analysis (segmentation) and synthesis (blending).

Finally, training study evidence indicates both blending and segmentation skills are necessary to affect reading. A review of training studies that have had positive effects on phonological awareness (for example, O'Connor, Jenkins, Leicester, & Slocum, 1993; Slocum, O'Connor, & Jenkins, 1993;

Torgesen, Morgan, & Davis, 1992) suggests that tasks that develop children's ability to segment and blend phonemes are crucial to developing automatic and fluent word recognition.

To further determine effective intervention, it is necessary to consider the method of instructional delivery. Training study literature indicates that explicit or direct instruction was most often used in studies resulting in positive effects on phonological awareness and reading skills (Fox & Routh, 1984; O'Connor, Notari-Syverson, & Vadasy, 1996; Weiner, 1994). This method of instruction has been repeatedly demonstrated to assist high-risk learners in the acquisition of basic skills.

Though direct, explicit instruction is necessary for children who have not developed phonological awareness, challenges exist to delivering this type of instruction in regular classrooms. Providing explicit instruction that is well planned, interactive, and closely monitored requires teacher time spent in planning and managing instruction for children who may represent only a small percentage of the total classroom group. Even when time can be found to implement such instruction, children do not necessarily master skills as a group. Teachers may not wish to hold back a group until every child has mastered each skill. To do so is limiting to children who learn at a faster rate. Providing for the needs of children who learn at slower rates can be difficult in diverse classrooms. Furthermore,

paraprofessionals, volunteers, and other personnel who might be available to provide help to teachers may not have received training in this kind of intervention. Lack of teacher time, insufficient training, and untested materials can all affect the ability of the teacher to deliver appropriate instruction to children at risk for reading failure.

Rationale for the Study

Computer-assisted instruction in phonological awareness may be a more viable alternative to classroom teachers than direct instruction. Computer-assisted instruction has proven effective in teaching a variety of reading skills (Jones, Torgesen, & Sexton, 1987; Leong, 1995; van Daal & Reitsma, 1990; Wise & Olson, 1994), including those subsumed under phonological awareness (Barker & Torgesen, 1995; Foster, Erickson, Foster, Brinkman, & Torgesen, 1994; Uhry & Shepherd, 1993). No research exists, however, on whether computer-assisted instruction is as effective in increasing phonological and reading skills as teacher-led instruction.

The purpose of this study was to compare the effects of computer-assisted instruction, teacher-led instruction, and no instruction on the phonological skills of children with deficits in phonological awareness. The same phonological skills were taught in each treatment group. Other variables (such as duration, stimulus words, and reinforcement) were identical. The salient difference between the two groups was

the medium of instructional delivery. By comparing the results of computer-delivered and teacher-led instruction, conclusions can be drawn about the relative effectiveness of each form of intervention. If children learn skills equally well or better when instructed by computer, teachers may be justified in providing computer-assisted instruction as a method for increasing phonological awareness.

Scope of the Study

In the following section, the delimitations and limitations of the study are discussed. Delimitations and limitations are important to consider when generalizing study results to other populations.

Delimitations

Participants were first-grade students identified by a phonological screening test as having deficiencies in phonological awareness skills. Gender and ethnicity were not considered in the selection process. Students identified by the screening test whose parent or guardian gave permission for participation in the study were pretested on measures of phonological knowledge and word and nonword reading ability. Participants were randomly assigned to one of three groups. Two groups received instruction in phonological awareness skills via the computer or in small teacher-led groups. The third group served as a control group and received no extra instruction. The research settings were three elementary schools in north central Florida.

Limitations

This study was conducted with first-grade students during the second half of the school year. The computer-assisted instruction was conducted with the DaisyQuest (1993) and Daisy's Castle (1993) software programs. Results of this intervention may not be generalizable to other software programs, especially if the content of such programs is not based on prior research. The teacher-led instruction was conducted by university graduate students outside the regular classroom. Because this arrangement offered fewer distractions to students, it may not be directly comparable to small group instruction taking place within the classroom. Thus, students in the direct instruction group may have enjoyed a slight advantage over children instructed under normal classroom conditions.

Definition of Terms

In this section key terms used in the chapters are defined more fully, and others relevant to the conduction of this study are discussed. Additional terms will be defined in later chapters as they occur.

Metaphonology is the ability of an individual to reflect on and consciously manipulate phonological segments and phonemes and is also referred to as metaphonological or metalinguistic skill (Hodson, 1994).

Onset and rime are defined as follows: The onset of a syllable includes any consonant sounds that precede the

vowel, and the rime refers to the vowel and all succeeding phonemes (Adams, 1990). In addition to analyzing and synthesizing at the word, syllable, and phonemic level, the tasks can be performed at the onset-rime level. For example, the word cat segmented at the onset and rime level is /k/ (onset) and /at/ (rime).

A phoneme is the smallest linguistic unit. It refers to one individual sound. The word cat has three phonemes, /k--/a--/t/. The word see has two phonemes, /s/ and /e/. There are 44 phonemes in the English language (Shaywitz, 1996).

Phoneme analysis is the ability to analyze words into single sounds (Yopp, 1988). It includes the ability to segment or separate linguistic elements such as words, syllables, and phonemes. For example, to segment the word cat, one could pronounce each of its phonemes separately (/k--/a--/t/).

Phoneme synthesis is the ability to blend isolated sounds into words (Yopp, 1988). It is demonstrated by tasks in which linguistic segments are blended together to form larger elements. Blending /k--/a--/t/ yields the word cat, for example.

Phonics is used to describe a method of reading instruction that teaches word recognition through learning grapheme-phoneme associations (Adams, 1990).

Phonological awareness is one's sensitivity to, or explicit awareness of, the phonological structure of the

words in one's language. It is demonstrated by tasks that require children to identify, isolate, or blend the individual phonemes in words (Torgesen, Wagner, & Rashotte, 1994).

Phonological processing refers to using phonological information to process oral and written language and encompasses phonological awareness and metaphonology (Hodson, 1994).

Summary

The purpose of this study was to determine the effects of computer-assisted instruction, teacher-led instruction, and no instruction on the phonological awareness skills and reading ability of first-grade students. Chapter II provides the theoretical basis upon which interventions based on phonological skills were grounded and contains a review of the relevant literature on phonological awareness intervention and computer-assisted instruction. Chapter III describes the methods and procedures that were used to conduct the study and analyze the resulting data. Chapter IV reports the results of the study, and Chapter V contains a discussion of the implications of the results for teachers, teacher educators, administrators, and other educational professionals.

CHAPTER II REVIEW OF THE LITERATURE

Chapter II provides the theoretical basis upon which interventions based on phonological skills are grounded and contains a review of the relevant literature on phonological awareness intervention and computer-assisted instruction. This chapter includes a summary and analysis of the research examining the relationship between phonological awareness and reading ability, the development of phonological awareness in good and poor readers, and instruction in phonological awareness. The literature on the efficacy of computer-assisted instruction in phonological awareness is also presented.

The chapter is divided into several sections. The relationship of phonological awareness skills and reading ability is discussed in the first section. The subsequent sections provide a discussion of the specific skills that make up the construct of phonological awareness, how instruction can help students acquire these skills, and challenges to implementing such instruction within the general education classroom. The chapter concludes with a summary of the research findings on the potential for computer-assisted instruction in phonological awareness,

including the implications of previous research for this study.

The Relationship of Phonological Awareness and Reading Ability

In this section the relationship of phonological awareness and reading ability is discussed. The section begins with a short discussion of the three types of experimental research that point to the causal relationship of phonological awareness and reading ability. The results of current neurophysiological and genetic research are described, and phonological models of reading that interface with this research are explained.

Evidence for a Causal Role

Phonological awareness is hypothesized by many researchers to be a developmental skill that has a causal relationship with reading ability. Two decades of correlational, longitudinal, and training research provide so much support to this hypothesis that the research findings appear irrefutable.

Correlational studies. Correlational studies are based on the view that phonological awareness is a developmental skill (Bradley & Bryant, 1985; Calfee et al., 1973; Fox & Routh, 1975, 1980; Rosner & Simon, 1971; Stanovich et al., 1988; Stanovich & Siegel, 1994; Tunmer & Nesdale, 1985; Vellutino & Scanlon, 1987). Thus, younger children should have fewer phonological awareness skills than older children, and poor readers perform similarly to younger children on

tests of phonological awareness. To test these hypotheses, two types of studies were conducted.

One set of studies examined the correlations between good and poor readers on tests of phonological awareness and reading ability. For example, Calfee et al. (1973) tested students from kindergarten through the 12th grade on their ability to match phonemes using a sequence of colored blocks to represent an auditory stimulus. A substantial correlation at all grade levels was found between performance on this auditory-phonetic test and reading ability as measured by the Wide-Range Achievement Test (WRAT) (Jastak & Jastak, 1978). In another correlational study (Tunmer & Nesdale, 1985), first-grade children were given an assessment of phonemic segmentation ability and reading achievement. Results indicated that word segmentation ability was positively related to reading achievement. Studies such as Calfee et al. (1973) and Tunmer and Nesdale (1985) indicated a positive relationship between the acquisition of phonological skills and a child's age and reading ability.

A second set of correlational studies showed that older and younger children matched on reading ability had similar performances on tests of phonological awareness (for example, Stanovich et al., 1988; Stanovich & Siegel, 1994). In the reading-level matched design, an older group of children with reading disabilities is compared with a younger group of children without reading disabilities. Various tasks are administered with the assumption that any differences that

are observed between groups cannot be the result of differences in reading ability. For example, Stanovich et al. (1988) tested groups of third-, fifth-, and seventh-grade students who were matched on reading ability. The various tasks administered included reliance on phonological information in decoding. Results indicated that task performances among the three grade level groups were similar. In another study, Stanovich and Siegel (1994) used a regression-based method analogous to the reading-level match design. The researchers divided 907 children (ages 7-16 years) into three groups based on reading ability. The children were compared on a set of tasks which included phonological activities. The results generally supported the phonological-core variable-difference model of reading disability. Results of the study showed the critical processing deficit impairing the word recognition process of persons with reading disabilities lies in the phonological domain, regardless of age or grade level.

Predictive studies. Predictive studies are based on the assumption that children deficient in phonological skills at the prereading stage will have difficulty acquiring reading skills. Conversely, children who show early facility with phonological tasks will more likely become good readers. Mann (1984) showed that future reading performance could be predicted by administering two tests of phoneme awareness, phoneme segmentation and invented spelling. Each test was given to 100 kindergarten children. One year later the same

children received standardized reading tests. Scores on each test of phoneme awareness predicted between 30% and 40% of variance in first-grade reading ability. Additionally, Bradley and Bryant (1985) followed over 400 children on their ability to detect rhyme and alliteration. Three and four years later, the initial scores bore a consistent and significant relationship to progress in reading and spelling. These and similar studies (Blachman, 1984; MacLean et al., 1987; Mann & Liberman, 1984) established a strong relationship between phonological awareness and subsequent reading skill.

Correlational and predictive studies by themselves, however, are not conclusive of a causal relationship. Some unknown factor that influences both phonological awareness and reading ability may exist. Phonological skill could influence reading ability, but the reverse might also be true. Alternatively, the relationship might be reciprocal, with each ability having an influence on the other. To establish causality, intervention studies are needed.

Intervention studies. If phonological awareness causes students to become proficient readers, then phonological awareness interventions should improve reading skills. A substantial number of studies have shown that phonological awareness skills can be taught and that increases in children's phonological awareness skills have consistently accompanied improvement in reading ability. Lundberg et al. (1988) used listening games, rhyming tasks, and segmentation

and blending of various linguistic components to increase the phonological awareness skills of 235 Danish preschool children. Bradley and Bryant (1985) trained children to categorize words by their sounds. The training had positive effects on reading and spelling skills. A host of other studies that support these findings are discussed later in this chapter.

The Neurobiology of Reading

In addition to the research supporting a causal link between phonological awareness and reading, neurobiological and genetic research support its existence. Although neurophysiological and genetic factors have long been known or suspected in cases of language and reading-related problems, the means for studying brain structures were lacking. With the advent of brain scan technology, research examining the structural anomalies of dyslexics' brains and differences in the locus of metabolic activity during reading is possible and informative.

Neurophysiological research. When the brain tissue of deceased dyslexic and nondyslexic individuals was examined (Galaburda & Geschwind, 1985), the dyslexic brains were found to have significantly more misplaced and unusually organized nerve cells. The anomalous cells were more numerous in the left hemisphere and included the language regions that border the Sylvian fissure. The neural tissue present in the temporal planum was symmetrical across the hemispheres of the

subjects with dyslexia, though the region is usually larger on the left in the general population.

In a review of research currently in progress under the aegis of the National Institute of Child Health and Human Development, Lyon (1995) reported that brain scans showed learning disabled groups tended to be more symmetrical. In dyslexic individuals, the absence of the normal left-greater-than-right asymmetry in the region of the posterior temporal planum indicates atypical neural organization. Thus, dyslexia is expressed in anomalous organization of the tissue and processing systems of the posterior left hemisphere.

Shaywitz (1996) reported research employing functional magnetic resonance imaging (fMRI) to measure changes in the metabolic activity of the brain while an individual identifies letters. Results showed that letter identification activates sites located in the occipital lobe, specifically the extrastriate cortex. Thus, it is believed that phonological processing takes place within the inferior frontal gyrus. Accessing the meaning of words appears to activate the middle and superior temporal gyri of the brain. Differences between males and females in the locus of phonological representation were also reported. When reading, males engaged the left inferior frontal gyrus, whereas females activated not only the left but the right inferior frontal gyrus as well.

As a result of the studies employing fMRI technology, scientists have concluded that deficiencies in word

recognition skills are associated with less-than-normal activation in the left temporal region and may be one possible explanation for the predominance of reading disabilities among men as compared to women. Additionally, positron emission tomography (PET) studies indicate that dyslexic adults have greater-than-normal activation in the occipital and prefrontal regions of the cortex (Lyon, 1995).

New developments in brain scan technology have facilitated the study of the structure and function of the brain areas involving reading. These studies help us understand the range of individual variability in brain structure and function and aid in the identification of the neurobiological causes of reading disabilities. In addition, new technologies for examining an individual's genetic makeup have allowed researchers to gather evidence about genetic determinants of reading ability.

Genetic research. Scientists have long speculated about a genetic relationship. For example, Locke (1994) proposed a genetic explanation for the lack of planar asymmetry in the brains of dyslexics. Locke's theory suggested that aspects of language acquisition develop at critically timed phases. These phases occur in sequence and are a result of stored utterances which activate analytical mechanisms for developing linguistic grammar. When the phases do not occur on time, the critical period for optimal development passes. Continued efforts to speak, however, stimulate atypical allocations of neural resources into linguistic service.

Locke proposed that this activation leads to compensatory growth in the right hemisphere which may account for the lack of asymmetry characteristic of some dyslexic brains. Locke speculated that genetic factors may influence the rate of brain development in children and that it is slow neurological maturation, not language development, that runs in families.

Some support for Locke's (1994) theory of compensatory growth in the right brain hemisphere came from investigations of neural plasticity. Neural plasticity allows for the modification of brain organization and function and is observed in response to injury or damage to the brain. An example of neural plasticity is the ability of hemispherectomy patients to recover bilateral motor and sensory functions. Recent experimental work has shown that some of the mechanisms believed to operate in the recovery of function can also be activated in the healthy brain during development (Witelson, 1987). The implication for children with reading disabilities is that intervention provided during the crucial period of early development might be more successful than remediation that occurs much later after the child has failed to learn to read. The identification of a genetic marker for reading disability might provide the means for early diagnosis and intervention.

Scientists at the Institute for Behavioral Genetics at the University of Colorado in Boulder have provided convincing evidence for a genetic basis for reading

disabilities (Cardon et al., 1994). These researchers have located a gene for reading problems on a small region of chromosome 6, one of the 23 pairs of chromosomes that compose the human genetic blueprint. The genetic studies in Colorado were combined with a study of 19 families at the Center for Hereditary Communication Disorders in Omaha. All of the study participants had average or higher intelligence and some type of reading disorder. The twins were ages 8 to 20, and the families studied comprised three generations. The twin study included one twin with reading problems and one without. By comparing genes in blood samples taken from participants with and without reading problems, the researchers were able to link an abnormality in a segment of chromosome 6 to reading problems. Strong evidence for genetic etiology of reading disabilities points to phonological awareness as reflecting the greatest degree of heritability (Lyon, 1995).

Neurophysiological and genetic factors affecting reading ability have long been hypothesized. Currently the means for studying brain structures and function as well as the genetic makeup of individuals with reading disabilities are available. Lyon (1994) summarized the conclusions from this research.

1. Dyslexia is related to anomalous organization of tissue and processing systems in the posterior left hemisphere.

2. Deficiency in word recognition skills is associated with less-than-normal activation in the left temporal region.

3. Dyslexic adults have greater-than-normal activation in the occipital and prefrontal regions of the cortex.

4. There is strong evidence for genetic etiology of reading disabilities.

5. Deficits in phonological awareness reflect the greatest degree of heritability.

6. At least one type of reading disability can be linked to a region of chromosome 6.

The implications of these results are important for children at risk for reading failure. Longitudinal studies show that of those children who are reading disabled in the third grade, approximately 74% remain disabled in the ninth grade (Lyon, 1995). Because strong evidence now exists that reading disabilities have a biological basis and represent a persistent deficit rather than a developmental lag, early identification and intervention are indicated. Brain scan technology and genetic testing may eventually provide the means to do so even before reading instruction begins.

Phonological Models of Reading

Taking into account results of experimental research and current neurophysiological and genetic findings, researchers have created phonological models of reading. These models help us understand the crucial role of phonological awareness in accomplishing the reading task and the importance of phonological awareness instruction to acquiring beginning

reading skills. Reading is made up of more than phonological awareness, however. In the following section, four reading processors are described.

The four reading processors. Adams's (1990) model of the reading processes involved in developing word knowledge incorporated four processors: (a) the orthographic processor, responsible for perceiving the sequences of letters in text, (b) the meaning processor, containing knowledge of word meanings, (c) the context processor, in charge of constructing an on-going understanding of the text, and (d) the phonological processor, which maps letters onto their spoken equivalents. The processors work together in a multidirectional manner, interacting by way of continuously relaying information and feedback to each other.

The orthographic processor enables the reader to accept information from print in the form of letter sequences. The vast majority of print consists of a relatively small store of very frequent words. These familiar words are processed visually. Each time a particular letter-sequence is encountered, the association between the letters is strengthened. In time, after enough encounters with the letter-sequence have occurred, the reader will perceive the sequence holistically. The sequence will no longer have to be processed letter-by-letter. The ability to process words as wholes vastly improves reading speed and accuracy. Familiar words and phrases can be processed automatically. Unfamiliar words can be processed quickly by pronouncing the

familiar letter-strings. Even pseudowords, if made up of familiar letter-sequences, can be easily and quickly decoded.

If the frequency of exposure to patterns of letter-strings produces strong associations enabling automatic word recognition, the opposite also holds true. Unfamiliar strings are processed, if at all, slowly and sluggishly. Less skilled readers who have not formed a store of associative links between individual letter-recognition units are slow and inaccurate decoders.

In order to make use of their store of letter associations to decode words, letter-strings from the printed page must first be encoded in their proper order. Knowledge about letter sequences facilitates encoding. The visual system can easily identify letters. Processing information about their spatial locations is slow and difficult unless they can be compared with previously formed letter sequence associations in memory. These associative links aid in encoding the spatial location of the identified letters. Once the order of the letters is accurately encoded, decoding of letter-sequences and whole words is facilitated.

There is at least one other service that letter-sequence associations perform for the reader. These associations allow longer words to be broken into syllabic units which can be analyzed as wholes. Skilled readers break long words down into syllabic units. They do so automatically and in the course of perceiving them. It is the store of letter-associated links that facilitates this automaticity.

In summary, the orthographic processor allows automaticity with familiar words. It facilitates speed and accuracy in decoding unfamiliar words. The inability of the orthographic processor to recognize unfamiliar letter-sequences explains the difficulty in decoding new or irregularly spelled words. The orthographic processor makes fast and accurate encoding possible and allows longer words to be analyzed as syllables.

The orthographic processor interacts with the meaning processor reciprocally. The meaning processor is activated when recognitions of whole words serve to turn on sets of associated meaning elements, or concepts. Concepts are formed by experience, and though differing among various individuals, given concepts share common elements. Over time, as an individual accumulates more and more experiences, concepts change and expand. Activation of associated meaning elements causes reciprocal activation of the spelling patterns they require. In this manner, the association between letter patterns and their meanings is strengthened and reinforced.

The context processor interacts with the orthographic processor and the meaning processor to construct an on-going understanding of the text. In so doing, it activates all meaning elements in the meaning processor that are compatible with its ongoing interpretation. If the context is strongly predictive of the word to follow, that word's meaning element is strongly activated. If weakly predictive, the activation

is dispersed over many units in the meaning processor. The context also plays a part in selecting among several alternatives the appropriate meaning for any given word.

The phonological processor accepts information in the form of speech. Less frequent words are analyzed by syllable and translated automatically to their phonological equivalents. The phonological translations serve both to turn on the word's meaning and its spelling, and the more such encounters occur with a word, the stronger direct spelling to meaning connections become.

How the phonological model works. The language system may be conceptualized as a hierarchical series of modules (Shaywitz, 1996). The upper levels involve semantics (word meanings), syntax (grammatical structure), and discourse (connected sentences). The lowest level, the phonological module, processes the sound elements (phonemes) that make up language.

The phoneme is the fundamental element of the linguistic system. For example, the word cat is made up of three phonemes (/k/--/a/--/t/). To identify words, the reader must break (or segment) them into individual sounds. Once the word is in its phonological form, it can be identified. Only after the phonological module identifies a word can it be understood. Thus, word identification (or decoding) is the fundamental task of the reader.

Both speech and reading rely on phonological processing. In contrast to spoken language, which is

apparently acquired instinctively when humans are exposed to speech, reading is an invention and must be learned at a conscious level. Learning to speak gives no clue to the segmental nature of language. In speaking, the individual phonemes in words are coarticulated or merged into a single unit of sound and automatically parsed back into words for the listener. In reading, the individual phonemes must be segmented for a word to be identified. The reader is faced with the task of transforming printed symbols into linguistic ones.

Though the orthographic, meaning, and context processors play important parts in the reading process, it is the phonological processor that plays the crucial role in beginning reading. In order to decode unfamiliar words, the phonological processor must analyze them by syllable. To do so requires the understanding that words are made up of sound units that can be separated (segmented) or merged (blended). It is this knowledge that we call phonological awareness. Similarly, what facilitates the strong direct spelling to meaning connections that allow the orthographic processor to decode words rapidly is knowledge of the mapping system, or grapheme-phoneme correspondences in the alphabetic system. Making sense of letter-sound instruction requires the knowledge that words are made up of individual sound units that can be segmented and blended. Therefore, the ability to acquire the alphabetic system rapidly is highly affected by phonological knowledge.

Summary of the Relationship of Phonological Awareness and Reading Ability

The relationship of phonological awareness to reading ability is documented by experimental research that shows its causal role in the development of reading skills. Adding to our understanding of this relationship is current research on the neurobiological and genetic aspects of reading disorders. Phonological models of reading help us understand the crucial importance of phonological awareness to the reading task. Because deficits in phonological knowledge represent the core deficit in reading disability (Lyon, 1995; Perfetti, 1986), phonological awareness is a crucial aspect of instruction for beginning readers.

The Construct of Phonological Awareness

Because instruction in phonological skills is an important part of beginning reading instruction, careful consideration must be given to the construct of phonological awareness. This issue is important because it affects decisions about the content of interventions. If phonological awareness represents a single ability, one intervention task should suffice to improve global ability. If the construct is actually a collection of several distinct abilities, then more than one skill may need to be taught.

Three areas of research suggest that phonological awareness consists of more than one skill. First, developmental evidence supports the concept that different phonological tasks present different levels of difficulty

(Smith, 1995) and that poor readers have fewer phonological skills than good readers, regardless of age (Stanovich et al., 1988). Second, construct validation evidence indicates that more than one phonological skill may significantly affect reading performance (Wagner et al., 1993). Finally, training study evidence suggests that the most effective interventions for increasing phonological awareness were those that consisted of multiple tasks (Davidson & Jenkins, 1994; Hurford, 1990; O'Connor et al., 1993; Slocum et al., 1993; Torgesen et al., 1992).

Development Evidence

A phonological task consists of manipulating sound units (or language components) based on a given criterion. The ability to perform the manipulation is assumed to demonstrate phonological awareness. Adams (1990) identified five levels of phonological tasks in order of their increasing difficulty: (a) rhyming, (b) oddity tasks, requiring the identification of rhyme or alliteration, (c) blending and syllable splitting, (d) phoneme segmentation, and (e) phoneme deletion. In the word oddity task, children are asked to choose one word from a set of three or more that does not belong according to a stated criterion. Word oddity tasks may be based on rhyme (example set--get, mat, or pet) or alliteration (example set--cat, cup, pal). Syllable splitting is performed at the onset-rime level. On hearing a word, the child must say either the onset or the rime (hear pair, say onset--/p/) or (hear pair, say rime--air). In

phoneme segmentation, individual phonemes must be isolated. In phoneme deletion, one of the isolated phonemes must be dropped (Say cat without /k/). The degree of difficulty of a phonological task is affected by two variables: the language component with which it must be performed and the complexity of the task. Smith (1995) developed a hierarchical framework of phonological tasks based on these two variables.

Language components. In Smith's (1995) developmental hierarchy of phonological tasks, the largest sound unit used to perform most tasks is the word. Phonological tasks at the word level do not require segmentation and, therefore, appear to be easiest. Tasks become increasingly more difficult when they must be performed at the syllable, onset-rime, and phoneme levels, respectively.

Smith's (1995) hierarchy indicated that the easiest divisions into which words can be separated are syllables and that phonological tasks at the onset-rime level involve a greater degree of abstraction, perhaps because, unlike syllables, the division between onset and rime units cannot be perceived in the normal pronunciation of a word. Adams (1990) and Wagner et al. (1993) suggested a different progression. They asserted that, in general, prereaders can perform tasks that require segmentation of words based on the intrasyllable units of onset and rime before they can perform these tasks with syllables. These experts agree, however, that the phoneme level requires the greatest level of

abstraction and, thus, is the most difficult level at which to perform phonological tasks.

Task complexity. Tasks representing simple phonemic awareness and compound phonemic awareness have been proposed (Clarke-Klein, 1994; Yopp, 1988). Clarke-Klein described a simple phonemic task, such as blending, as a task requiring only one phonological manipulation. In blending, individual phonemes must be coarticulated. A compound phonological task consists of two manipulations. Phoneme reversal is a compound task because it requires first that individual sound units be isolated and then that they be manipulated. For example, to perform the reversal task, one must say a word backwards (pal becomes lap). To accomplish this, the individual phonemes must first be segmented. Then the order of the phonemes must be reversed.

In Smith's (1995) developmental hierarchy, easier phonological tasks are designated as appropriate at the preschool/kindergarten level. In order of increasing difficulty, these tasks are (a) word oddity, (b) sentence segmentation by words, (c) word segmentation by syllables, and (d) sound matching. Sentence segmentation by words involves counting words heard in a sentence. Word segmentation by syllables consists of clapping or counting syllables in a word. Sound matching may follow several formats such as matching initial phonemes, matching final phonemes, and matching medial phonemes.

More difficult tasks are appropriate at the kindergarten/first grade level. These include (a) blending, (b) word manipulation, (c) syllable splitting, (d) phoneme segmentation, and (e) phoneme manipulation. Blending may be performed at the syllable, onset-rime, or phoneme level. Word manipulation, sometimes called elision, is a deletion task that can be performed at the word level (Say baseball without saying base), at the syllable level (Say winter without saying ter), and at the onset-rime level (Say mat without saying /m/). In phoneme manipulation, a deletion or reversal task must be performed at the phoneme level.

Correlational studies such as those previously discussed (Calfee et al., 1973; Stanovich & Siegel, 1994; Stanovich et al., 1988; Tunmer & Nesdale, 1985) provide further evidence of the developmental nature of phonological awareness. In these studies, typically performing younger children had fewer phonological skills than older readers. Older and younger children matched on reading ability had similar performances on tests of phonological awareness, and poor readers had fewer phonological skills than good readers.

In summary, developmental evidence seems to suggest that phonological awareness is not a unitary construct but may consist of multiple skills representing distinct aspects of a complex ability. In the following section, the existence of phonological awareness as a unitary construct or a group of distinct abilities is further explored.

Construct Validation Evidence

Clarke-Klein's (1994) description of simple and compound phonological awareness was based on a principal factor analysis of phonological awareness tasks (Yopp, 1988) in which the two highly related factors emerged. Factor 1 tasks require one operation (i.e., segment, blend, or isolate a given sound). Factor 2 tasks require more steps to completion. These tasks require that children perform one operation (isolate a given sound) and then hold the resulting sound in memory while performing yet another operation. In the elision test, for example, the child must recall the remaining sounds and blend them (Say "frog" without /r/).

Confirmatory factor analysis has been used in several studies investigating the question of whether phonological awareness is a unitary construct or consists of multiple and distinct skills. Confirmatory factor analysis is an application of structural equation modeling that combines a structural model linking latent variables (unobservable constructs) with observed variables providing reliable measures of the latent variables (Moore, 1995). The constructs are arranged in a model that shows how they are related in a given theory. The hypothesized factor model implies a structure in the data that may be compared to actual data. To the degree that these two structures match, a factor can be "confirmed."

Wagner et al. (1994) used confirmatory factor analysis to compare alternative models of phonological processing

abilities in 184 kindergarten and grade 1 children. There were five latent variables: (a) synthesis, (b) analysis, (c) memory, (d) serial naming, and (e) isolated naming. The synthesis and analysis tasks assessed phonological awareness. Synthesis and analysis as two separate but correlated factors were confirmed.

A longitudinal study of the phonological processing and reading abilities of 244 kindergarten children (Torgesen et al., 1994) supported a different conclusion. Torgesen et al. used the five assessment tasks validated by Wagner et al. (1994) to measure phonological processing skills. These children were given a battery of 22 tasks that assessed the five phonological abilities, reading and prereading skills, and general verbal ability. The tasks were similar to those in the Wagner et al. study. All tasks were readministered to the same children at the beginning of first and second grades. Performance on each phonological task had a statistically significant influence on first-grade word-reading skill when they were considered in isolation. However, when the five phonological tasks were analyzed as simultaneous causes, only one of the phonological variables (phonological analysis, a measure of phonological awareness) was significant. Performance on each phonological task had a statistically significant influence on second-grade word-reading skill also. However, when the five phonological tasks were analyzed as simultaneous causes, only phonological synthesis was significant. Torgesen et al. (1994) readily

conceded that had they included a more fine-grained analysis of different types of reading skill (e.g., accuracy as opposed to fluency), they might have been able to show that their five phonological skills contributed differentially, depending on the type of reading skill to be explained.

In McBride-Chang's (1995) analysis, phonological awareness was measured with three separate tasks. These tasks were position analysis, phoneme deletion, and phoneme segmentation. The position analysis task required children to identify the position of a phoneme in a nonsense word (Say nelf. Does /f/ come before or after /l/?). Results showed all three tasks were significantly related to phonological awareness. Position analysis loaded highest (.84) on the phonological awareness construct, and phoneme segmentation loaded lowest (.78).

In summary, evidence exists for a number of correlated factors that make up the construct of phonological awareness. Results of research attempting to isolate those factors that contribute significant variance to reading ability have been inconclusive. The factors most often emerging in these studies are phonological analysis and synthesis.

Training Study Evidence

Several studies have manipulated the combinations of phonological awareness skills taught and compared groups in an effort to determine which skills produced the greatest effects on measures of phonological awareness and reading (Davidson & Jenkins, 1994; Hurford, 1990; O'Connor et al.,

1993; Slocum et al., 1993; Torgesen et al., 1992). The Torgesen et al. (1992) study included 48 kindergarten children randomly assigned to three groups. The children were matched on age and verbal ability. One group of children learned blending and segmenting skills, while the second group practiced blending only. The third group served as a control group and received equal instructional time in reading and writing activities similar to the Language Experience Approach. Results indicated that instruction in blending alone was not sufficient to affect reading as measured by a reading analog test (using letter-like forms). The group taught blending plus segmenting performed significantly better than the control group. One limitation of this study was the lack of a segmentation only group.

Davidson and Jenkins (1994) studied 40 kindergarten children who were divided into four groups. Group A received segmentation training only; group B received blending only; and group C received training in both skills. The fourth group served as a no-treatment control group. Results showed that training in one skill did not seem to improve the other skill. Significant effects on an analog word reading test were noted for the segmentation-only group and the segmentation-plus-blending group, but not for the blending alone group.

Slocum et al. (1993) examined the effects of various sequences of skill training with 35 prekindergarten children. Those children taught blending and then segmenting were

compared with those who received segmenting training first and then blending. As in the Davidson and Jenkins (1994) study, Slocum et al. noted no indication of transfer across phonological tasks. An analysis of the effects of sequence of training showed no significant differences as measured by onset-rime segmentation and blending.

In contrast, Hurford (1990) taught children auditory discrimination of phonemes and found that the training improved segmentation ability. The study suggests that phonemic discrimination is a necessary yet insufficient skill for phonological awareness. A weakness of the study was the lack of a nonphonemic training group.

Summary of the Construct of Phonological Awareness

In summary, three sources of evidence provide support for the conclusion that phonological awareness consists of more than one skill. Evidence of the developmental nature of phonological skills suggests the existence of a hierarchy based on the level of difficulty of each skill. Construct validation evidence indicates that more than one phonological skill significantly affects reading performance. Finally, training study research indicates that teaching one skill does not necessarily result in an increase in other phonological skills. Best practice seems to require that interventions designed to increase phonological awareness include a combination of phonological skills.

The Content of Phonological Awareness Instruction

If interventions including a combination of phonological tasks are warranted, there is a need to determine those tasks that have been most successful in increasing phonological awareness skills. The following section includes a review of the research on phonological training. The purpose is to examine the results of such research to determine which phonological skills should be included in an intervention to increase phonological awareness.

Selection of Studies

Research published in refereed journals from 1970 to the present was identified through the ERIC information resource and by hand searching current issues of relevant journals. Reference lists of selected articles were examined to identify additional training studies to be included in this review. Studies meeting the following criteria were reviewed.

1. Participants and settings were thoroughly described.
2. Descriptions of treatments were detailed enough to permit replication.
3. The experimental designs and data analyses were sufficiently explained.
4. Interpretations were consistent with the results displayed.

In accordance with these criteria, 45 articles containing one or more intervention studies in the area of phonological awareness were reviewed.

Early Studies

In the 1970s, evidence began to accrue that some combination of phonological skills was necessary to enable children to acquire basic literacy skills. Table 1 summarizes the research in phonological awareness that took place in the 1970s.

Rosner (1974) investigated whether preschoolers could learn auditory word analysis skills. Positive results from this work were followed by other investigations in which researchers sought to isolate the variables that affect the acquisition of segmentation and blending skills. These studies examined the effects of sequential memory skill (Goldstein, 1976), phoneme position (Marsh & Mineo, 1977), unit of analysis (syllable or phoneme level) (Liberman, Shankweiler, Fischer, & Carter, 1974), and visual phoneme representation with tiles or letters (Haddock, 1976; Marsh & Mineo, 1977) on blending or segmenting training. Other aspects of this research attempted to establish whether segmentation skill is prerequisite to blending or if the relationship is reciprocal (Fox & Routh, 1976;). The issue of transfer to new word contexts was also investigated (Marsh & Mineo, 1977). Significant increases in phonological skills (Liberman et al., 1974; Marsh & Mineo, 1977; Rosner, 1974) or reading ability (Fox & Routh, 1976; Goldstein, 1976; Haddock, 1976) were found in these early studies. The following is a summary of their conclusions:

Table 1

Early Research in Phonological Awareness (1970s)

Study	Subjects	Dependent Measures	Intervention	Duration
Fox & Roth (1976)	40 Prekindergarten Age 4 (average learners)	Reading analog tasks	Proficient segmenters Group 1. Blending instruction Group 2. No blending Nonsegmenters Group 3. Blending instruction Group 4. No blending instruction	To criteria
Results: Significant positive gains in reading only for those children already proficient in segmentation. No evidence of generalization from blending to segmentation.				
Goldstein (1976)	23 Prekindergarten Age 4.5	Sequential memory skill task Word analysis and synthesis skill tasks Reading achievement tests	Group 1. Blending, segmenting & letter sound instruction Group 2. Sequencing tasks & naming letters	10 minute sessions 5 sessions per week 13 weeks
Results: Group 1 produced significantly higher gains on reading measures. Limitations: Small N, nonequivalent groups, and nonrandom assignment weaken the design of this study.				

Table 1--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Haddock (1976)	80 Prekindergarten Age 5	Blending test (word reading)	Group 1. Auditory blending & letter-sound instruction Group 2. Auditory blending using manipulative letter tokens Group 3. Letter sound instruction only	10 minute sessions 5 sessions per week 3 weeks
Results: Significantly greater gains for Groups 1 and 2. Group 2 was significantly higher than Group 1. Limitations: Unequal cell sizes. Did not assess segmentation skills. Results may have been due to blending plus segmentation, not blending alone.				
Liberman, Shankweiler, Fischer, & Carter (1974)	135 Preschool to grade 1 (average learners)	Segmentation task	Group 1. Tapping out number of syllables and phonemes (segmentation) Group 2. No intervention	4 sets of trials to criterion
Results: Fewer younger than older children reached criterion on segmentation task. Younger children required more trials than older children to reach criterion.				

Table 1--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Marsh & Mineo (1977)	64 Prekindergarten Age 5 (average learners)	Phoneme identification during training Phoneme identification during transfer to new words	Group 1. Phoneme identification given visual cueing (letters) Group 2. Phoneme identification with colored cards representing letters	8 days
Results: There were no significant effects for phoneme position, transfer for visual (letter) cue, or phoneme contrast. Continuants (/m/ /f/ /s/) were easier to learn than stop sounds (/p/ /t/ /d/). Limitations: Short duration.				
Rosner (1974)	145 Prekindergarten & kindergarten Age 4 & 5	Criterion referenced test for each objective in program	Auditory analysis training program (oral phonological tasks) Group 1--inner city Prekindergarten Group 2--Suburban kindergarten Group 3--inner city kindergarten-control (no intervention)	As part of reading curriculum 2 school years
Results: Significantly more objectives were mastered by Group 1 than Group 3. Significantly more objectives were mastered by Group 2 than Group 1. Limitations: Unequal cell sizes. Subjects were not randomly assigned or matched on ability.				

1. Preschool children can be taught segmentation and blending skills.
2. Some combination of blending, segmentation, and letter-sound knowledge appears to enhance reading skills.
3. Segmentation at the phoneme level is more difficult than at the syllable level and develops later.
4. There may be no transfer effects for training one phonological skill to the acquisition of a second phonological skill.

Components of Effective Interventions

Beginning in the 1980s, studies began to focus more clearly on the components of effective intervention. The most frequently included tasks in these studies were segmentation, blending, and rhyming. Less frequently included tasks were deletion, phoneme identification, and phoneme substitution. The following is an overview of the phonological training studies conducted from 1980 to the present.

Longitudinal studies. Table 2 summarizes the longitudinal training studies that have been conducted with phonological awareness. Longitudinal studies are important because they indicate effects of long-term training and show whether training effects are maintained over time. These studies (Bradley & Bryant, 1985; Byrne & Fielding-Barnsley, 1993; Foorman, Francis, Novy, & Liberman, 1991; Kozminsky & Kozminsky, 1995; Lie, 1991; Lundberg et al., 1988; McGuinness et al., 1995; Olofsson & Lundberg, 1985; Williams, 1980) have

Table 2

Longitudinal Training Studies

Study	Subjects	Dependent Measures	Intervention	Duration
Bradley & Bryant (1985)	N = 65 Age 6 (average learners with deficient phonological discrimination)	Sound categorization (oddy task) Neale Analysis of Reading Schonell Test of Reading Schonell Test of Spelling	Group 1. Rhyme, alliteration, global phonological awareness (PA) activities Group 2. Above combined with manipulative letters Group 3. Conceptual categorization of words Group 4. No intervention	1 session per week 2 years
Results: Group 2 made significant gains over Groups 3 and 4 on reading and spelling measures. No significant difference between Groups 1 and 2 on reading measures. Group 2 significantly surpassed Group 1 in spelling.				
Byrne & Fielding-Barnsley (1993)	N = 19 Age 6 (Australia) (average learners)	Phoneme identity Elision Alphabet knowledge Word identification (WWT-R) Pseudoword identification	Group 1. Identification of phonemes and letter-sound practice. Group 2. Story reading, semantic categorization games	One year follow-up of Byrne & Fielding-Barnsley (1991)
Results: Children with advanced levels of phonemic awareness (regardless of initial group membership) scored significantly higher on each of the dependent measures. The authors concluded that some aspects of phonemic awareness may be a consequence of literacy instruction rather than a cause.				

Table 2--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Foorman, Francis, Novy, & Liberman (1991)	N = 80 Grade 1 Age 6 (average learners)	Gates-MacGinitie Reading Test Segmentation test Researcher-constructed reading, spelling tests	Group 1. Letter-sound instruction w/segmentation & blending training Group 2. Whole word in context instruction	45 minutes daily 1 year
Results: Growth curve analyses (using hierarchical linear model) showed Group 1 improved at a faster rate than Group 2 for phonetically regular and exception words.				
Kozminsky & Kozminsky (1995)	N = 150 (70 Kindergarten 53 Grade 1 27 Grade 3) (Israel)	Lindamood Auditory Conceptualization (LAC) Phonological Awareness Test (PAT) Reading Comprehension Test	Group 1. Listening games, rhyming, segmentation, blending, deletion, letter-sound instruction. Group 2. Visual-motor integration training.	20 minute sessions 2 sessions per week 8 months
Results: Significantly higher scores on the LAC for PA for the PA-trained group at all grade levels. Initial sound isolation and sound deletion explained 70% of the reading comprehension score variability in grade 1 subjects.				

Table 2--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Lie (1991)	N = 208 Grade 1 Age 7 (Norway)	Reading test Spelling test	Group 1. Segmentation--sequential training (identification of sounds in sequence in words) Group 2. Segmentation--positional training (identification of beginning-middle-ending sound) Group 3. Look at illustrations, other "neutral" activities	10-15 minute sessions 5 sessions per week 1 school year
Results: Those taught segmentation by identifying sounds in sequence made significant gains in reading at the end of Grade 1. There was a significant main effect for IQ. Those with lower ability showed greater effects on dependent measures.				
Lundberg, Frost, & Petersen (1988)	N = 390 Kindergarten Age 6 (Denmark)	Language completion task Vocabulary Letter knowledge Reading Metaphonological tasks (rhyme, segmentation, synthesis, deletion)	Group 1. Various games such as listening, rhyming, segmentation, blending, & letter-sound instruction Group 2. Regular program--no letter-sound instruction	15-20 minute sessions 5 sessions per week 8 months (follow-up testing at grades 1 and 2)
Results: Significant gains for group 1 relative to control group on reading and spelling at grades 1 and 2. Limitations: Nonrandom assignment. Effects on reading were only marginally significant.				

Table 2--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
McGuinness, N = 42 McGuinness, Age 5-8 & Donohue (1995)	(above average verbal ability)	LAC WRMT-R word attack, word identification	Group 1. Auditory Discrimination in Depth (ADD) program (phoneme isolation and identification) implemented within whole-language classroom Group 2. ADD within traditional classroom	20-30 minutes daily 5 sessions per week 8 months
Results: Comparable gains on the LAC and WRMT-R subtests were reported for both groups taught with ADD method. ADD was found to be an effective means of delivering PA and letter-sound instruction in both whole language and traditional classrooms. Limitations: Small N for multiple regression analysis. Nonrandom assignment.				
Olofsson & N = 83 Iandberg (1985)	(follow-up of 1983 study) (Sweden) (below average phonological awareness and reading)	Synthesis Analysis Spelling Reading	Group 1. Rhyming, segmentation, phoneme identification, deletion, blending Group 2. Nonverbal sound discrimination Group 3. Regular classroom preschool program	Longitudinal analysis 1 year after intervention
Results: Long-term effects of PA training were demonstrated on PA tasks. Transfer to reading and spelling was not demonstrated.				

Table 2--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Williams (1980)	N = 127 Age 7-12 (students with specific learning disabilities)	Syllable analysis Syllable blending Letter-sound correspondence Decoding Phoneme analysis Phoneme blending	Group 1. Segmentation, blending, letter-sound practice Group 1. Traditional classroom reading program	30 minutes daily 26 weeks 2 years

Results: At the end of year 1, significant gains were reported for Group 1 on measures of phonological awareness. At the end of year 2, significant gains were reported for every measure, and significant positive gains were noted for Group 1 versus the control group on all but one measure.

included a wide array of phonological skills taught to children over an extended period of time. The Lundberg et al. study is representative of many of these longitudinal studies. In this research, 390 Danish kindergarten children (age 6 in Denmark) were trained over a period of 8 months. The training program consisted of metalinguistic games and exercises to stimulate children to discover and attend to the phonological structure of language. These games and exercises consisted of the following activities:

1. Listening games (nonspeech and speech sounds).
2. Identifying the rhyme and creating rhymes.
3. Identifying repeated words, dividing sentences into their component words, and reflecting upon the length of words.
4. Segmenting words into syllables or into subsyllabic units.
5. Blending syllables into words, blending syllables from different words, and blending subsyllabic units into words.
6. Phoneme segmentation (initial, middle, and/or final phoneme in a word).
7. Counting syllables, subsyllabic units, or phonemes in a word.
8. Blending phonemes into a word.
9. Sounding the remaining part of a word following a phoneme deletion.

Results of the Lundberg et al. (1988) study indicated significant positive effects for the treatment group versus the control group on phonological measures of rhyming, blending, segmentation, and deletion. The difference at grade 1 and grade 2 on reading skills between the experimental and control groups was significant. A weakness of the study was the nonrandom assignment of participants to classrooms and the nonrandom assignment of classrooms to groups.

Kozminsky and Kozminsky (1995) replicated the Lundberg et al. (1988) study with 150 age 6 Hebrew-speaking children. Children were randomly assigned to classrooms and groups. Children in the experimental group engaged in activities similar to those in the Lundberg et al. study. Children in the control group were given activities promoting visual-motor integration. Results showed children receiving the phonological awareness training had significantly higher scores than the control group on the phonological tasks of the Lindamood Auditory Conceptualization (LAC) test. Initial sound isolation (phoneme identification) and sound deletion explained 70% of the reading comprehension score variability in grade 1.

Longitudinal studies showed children could be taught a broad array of phonological skills, that these skills positively affected reading skill, and that the effects were maintained over time. Other studies focused on teaching the same phonological awareness tasks over a shorter period of

time. These studies can be organized into two categories: (a) interventions consisting of phonological awareness skills alone and (b) interventions consisting of phonological awareness skills taught in combination with letter-sound practice.

Teaching phonological skills alone. Teaching phonological tasks without practice with letter-sound correspondence has consistently resulted in increased phonological awareness (O'Connor et al., 1993; Slocum et al., 1993; Torneus, 1984). Other studies have shown that teaching phonological skills alone has resulted in both increased phonological awareness and reading skill (Brady, Fowler, Stone, & Winbury, 1994; Cary & Verhaeghe, 1994; Davidson & Jenkins, 1994; Fox & Routh, 1984; O'Connor et al., 1996; Torgesen et al., 1992; Treiman & Baron, 1983). Table 3 summarizes this research.

An important aspect of this research focused on determining which skills should be taught and in what combinations. Fox and Routh (1984) compared children taught segmentation alone to a group taught segmentation plus blending. The segmentation plus blending group was significantly better on measures of phonological awareness and reading. A weakness of the study was the lack of a blending only group.

Torgesen et al. (1992) compared a group taught segmentation and blending to a group taught blending alone and a control group. The children were matched across groups

Table 3

Studies Training Phonological Awareness Without Letter-Sound Practice

Study	Subjects	Dependent Measures	Intervention	Duration
Brady, Fowler, Stone, & Winbury (1994)	N = 42 Age 5-4 ("at risk"---inner-city schools)	Achievement measures Letter identification Word identification (WRMT-R) Word Attack (WRMT-R) Spelling Phonological measures Rhyme Segmentation Deletion Basic phonological processes Perception Memory span Speech production Boston Naming Test	Group 1. Oral PA activities Rhyming Segmentation Phonemic categorization ADD program Segmentation using manipulative tokens Group 2. Regular classroom instruction (whole language approach)	20 minute sessions 3 sessions per week 18 weeks Follow-up 1 year later

Results: No significant differences on achievement measures. Significantly higher gains for Group 1 on rhyming, segmentation, and speech production. At follow-up (1 year later), Group 1 performed significantly better on WRMT-R Word Identification and Word Attack.

Table 3--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Cary & Verhaeghe (1994)	Experiment 1 N = 32 Age 5-6 (low SES)	Rhyme Segmentation of sentences Syllable deletion Syllable synthesis Syllable segmentation Phoneme deletion Phoneme segmentation Awareness of articulatory gestures (position of articulators)	Group 1. Games involving rhymes, syllables, and phonemes Group 2. As above, but without games involving phonemes Group 3. No intervention	30 minute sessions 2 sessions Per week 7 weeks
	Experiment 2 N = 47 Age 5-6 (low SES)	Rhyme detection Syllable deletion Syllable segmentation Phoneme deletion Phoneme segmentation	Group 1. Phoneme analysis only Group 2. Syllable analysis only Group 3. Activities similar to Groups 1 and 2 but with visual, nonlinguistic material	30 minute sessions 2 sessions per week 8 weeks

Results: Group 1 displayed significant performance progress in all subtests. Group 2 displayed significant performance progress in rhyme and syllable level tasks only. The results seem to indicate that facility with tasks at the rhyme and syllable level does not generalize to phonemic tasks. In contrast, analysis training with phonemes can enhance awareness at the rhyme and syllabic level. Thus, phonemic awareness at the phoneme level must be explicitly instructed.

Table 3--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Davidson & Jenkins (1994)	N = 40 Kindergarten Age 6	Phonemic generalization tests (blending, segmentation) Transfer tasks (reading & spelling)	Group 1. Blending only Group 2. Segmentation only Group 3. Both blending & segmentation Group 4. No intervention	10 minute sessions 5 sessions per week 8-12 weeks (to criterion)
Results: Blending test: Group 1 and Group 3 made significantly higher gains than Groups 2 and 4. Segmentation test: Group 2 and Group 3 made significantly higher gains than Group 1 and Group 4. Reading and spelling measures: Group 2 and Group 3 made significantly higher gains than Group 1 and 4. This study found transfer on a word reading analog test for Groups 2 and 3. This study found no evidence of generalization from blending training to segmentation or vice versa.				
Fox & Roth (1984)	N = 41 31 Kindergarten "nonsegmenters" Age 5-6 10 Kindergarten "segmenters" (average learners)	Segmentation Blending Reading analog tasks	Group 1. Segmentation practice Group 2. Segmentation plus blending practice Group 3. No intervention	15 minute sessions 4-5 sessions per week 5 weeks
Results: Group 2 was significantly higher on all tasks. No generalization from segmenting to blending was indicated. Limitations: Study lacked a blending only group.				

Table 3--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
O'Connor, Jenkins, Leicester, & Slocum (1993)	N = 47 Preschoolers Age 4-6 (special education students)	Rhyming Blending Segmenting	Group 1. Rhyming practice Group 2. Blending practice Group 3. Segmentation practice Group 4. No intervention (proficient PA skills)	10 minute sessions 4 sessions per week 7 weeks
Results: Significant gains for Group 2 and Group 3 on all measures compared to Groups 1 and 4. Little transfer between blending and segmentation tasks.				
O'Connor, Notari-Syversen, & Vadasy (1996)	N = 107 Kindergarten Age 5-6 31 with disabilities 57 regular education, low SES 19 Retained	Sound repetition, letter naming, Syllable deletion, rhyming, blending identify first sound, segmentation, Woodcock- Johnson Tests of Achievement-Revised (WJ-R) Letter-Word, Identification subtest, WJ-R Dictation subtest	Group 1. Combination of phonological activities (word & syllable awareness, rhyming, blending, segmentation) Group 2. No intervention	5-15 minutes daily 6 months
Results: Significant positive effects for Group 1 for blending, segmenting, reading, and writing measures. Children with disabilities made fewer gains than retained kindergartners. Limitations: Retained kindergartners' gains may be due to small amounts of reading instruction and second year of exposure to kindergarten objectives. Ceiling effects for PA measures were reported.				

Table 3--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Slocum, O'Connor, & Jenkins (1993)	N = 35 Prekindergarten Age 5 (low receptive language)	Segmentation Blending	Phase 1 Group 1. Blending then segmenting instruction Group 2. Word manipulation then segmenting Phase 2 Group 1. Segmenting then blending instruction Group 2. Word manipulation then blending.	10 minutes sessions 5 sessions
Results: Phase 1: Group 1 performed significantly better on the blending test only. Phase 2: Group 1 performed significantly better on the segmentation test only. No indication of transfer across phonological tasks was noted.				
Limitations: Floor effects prevented detection of small gains so effect sizes could not be established.				
Torgesen, Morgan, & Davis (1992)	N = 48 Age 6 (at risk)	Segmentation Blending Letter-sound Word-learning synthesis (reading)	Group 1. Blending alone Group 2. Segmentation + blending Group 3. Language Experience Approach	20 minute sessions 3 sessions per week 7-8 weeks
Results: Group 1 was significantly higher than Group 3 in blending only. Group 2 was significantly higher than Group 3 in segmentation and blending. Group 2 was significantly higher than Group 3 on reading. Learning to blend did not transfer to skill in segmentation.				
Limitations: The blending plus segmenting group received an extra week of the intervention. The study lacked a segmentation only group.				

Table 3--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Torneus (1984)	N = 38 Grade 1 Age 7 (average learners) (Sweden)	Segmentation Sound blending Reading task Spelling task	Group 1. Phonological awareness activities (rhyme, alliteration, segmentation, blending) Group 2. General language activities	20 minute sessions 1 session per week 8 sessions
Results: Group 1 improved relative to Group 2 on all measures. The lowest skilled children in Group 1 at pretest improved in PA and spelling but not in reading. Limitations: Ceiling effects on segmentation test. Short duration.				
Treiman & Baron (1983)	Experiment 1 N = 8 Kindergarten Age 5	Reading Task	Experiment 1 Group 1. Analysis training Group 2. No analysis training	5 days (to criterion)
	Experiment 2 N = 20 Kindergarten Age 6		Experiment 2 Group 1. Analysis + blending Group 2. No analysis or blending	
Results: In both experiments 1 and 2, a significant interaction was found between group and item type in the reading task, suggesting a causal link between the ability to analyze spoken syllables and the ability to benefit from spelling-sound relations in reading. Limitations: No synthesis (blending) alone condition.				

on age and verbal ability. Measures of segmentation, blending, and reading indicated significant positive effects for the blending-only group versus the control group on the blending test only. Significant positive effects were found for the segmentation-plus-blending group on all three measures. The researchers concluded that teaching blending plus segmentation was sufficient to significantly affect reading skills. As previously discussed, a limitation of the study was the lack of a segmentation-only group.

A similar result was obtained in a study that taught a different skill--blending, segmentation, or rhyming--to each of three groups (O'Connor et al., 1993). They were compared with a control group receiving no intervention. Based on measures of segmentation, blending, and rhyming, only the segmentation and blending groups made significant gains in all areas.

The Davidson and Jenkins (1994) study discussed previously included three groups--segmentation only, blending only, and segmentation plus blending. The study also included a no treatment control group. The segmentation-plus-blending group made significant gains on both measures of phonological awareness. On the word reading measures, the one group failing to make significant increases was the blending-only group.

In their examination of the importance of sequencing in phonological training, Slocum et al. (1993) taught blending and then segmenting to one group of at-risk prekindergarten

children and segmenting and then blending to the second group. Those taught blending performed significantly better on the blending test. Those taught segmenting performed significantly on the segmenting test. The order of presentation of the skills had no effect. The researchers reported floor effects that may have prevented detection of small gains. They suggested that low verbal skills and lack of motivation of participants may have affected results.

Summary of interventions employing phonological instruction alone. Interventions instructing children in phonological awareness have been successful in increasing phonological and reading skills. The majority of significant effects on phonological and reading skills have been found in groups taught segmentation-plus-blending skills.

Phonological skills combined with letter-sound training. Further training study evidence suggests that phonological awareness instruction may be effective when combined with letter-sound practice. Combining segmentation training with instruction and practice in letter-sound correspondence has been investigated in several studies (Ball & Blachman, 1988; Bentin & Leshem, 1993; Blachman, Ball, Black, & Tangel, 1994; Byrne & Fielding-Barnsley, 1991; Defior & Pio Tudela, 1994; Tangel & Blachman, 1992; Vellutino & Scanlon, 1987). Table 4 summarizes this research.

In two studies representative of this type of intervention, Blachman et al. (1994) and Tangel and Blachman (1992) taught segmentation in combination with letter-sound

Table 4

Studies Training Phonological Awareness and Letter-Sound Practice

Study	Subjects	Dependent Measures	Intervention	Duration
Alexander, Anderson, Hellman, Voeller, & Torgesen (1991)	N = 10 Age 8-13 (severe dyslexics)	WRMT-R Word Identification Word Attack LAC	ADD program (phoneme isolation and identification)	Total 38-124 hours
Results: Significant gains on both measures of reading and the measure of phonological awareness.				
Limitations: This study lacked a control group but is often cited because of the severity of participants' reading disability.				
Ball & Blachman (1988)	N = 90 Kindergarten Age 6 (average learners)	Segmentation test Letter naming WJ-R Word Identification Word List	Group 1: Segmentation & letter-sound practice Group 2: Language awareness activities Group 3: No intervention	20 minute sessions 4 sessions per week 7 weeks
Results: Significant gains for Group 1 on segmentation and word reading measures. No differences in letter naming.				

Table 4--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Ball & Blachman (1991)	N = 89 Kindergarten Age 6 (average learners)	Segmentation Letter-names Letter sounds WRMT-R Word Identification Word reading Spelling	Group 1. Segmentation, letter-sound practice, alliteration, spelling by sounds, rhyming Group 2. Letter-sound practice combined with language activities Group 3. No intervention	20 minute sessions 4 sessions per week 7 weeks
Results: Significant gains for Group 1 on segmentation and reading tasks. Limitations: Subjects may have received blending training in classroom program.				
Bentin & Leshem (1993)	N = 508 Age 5.5 Israeli (lower quartile on PA)	Phoneme isolation Phoneme matching Phoneme addition Phoneme deletion Reading tests	Group 1. Phonemic segmentation with colored tokens Group 2. Phonemic segmentation with letter shapes Group 3. General language skills Group 4. (Low PA at pretest) No intervention Group 5. (High PA at pretest) No intervention	30 minute sessions 2 sessions per week 10 weeks Follow-up at 4 and 9 months
Results: Reading performance assessed 4 and 9 months after training showed similar results for Groups 1 and 2. These two groups performed significantly better than Groups 3 or 4 on all measures and similar to Group 5. The authors concluded that learning to read is the most important factor affecting the acquisition of phonemic segmentation skills in first grade. The emergence of phonemic awareness requires a previously developed sensitivity to phonology, and this development by explicit training can prevent reading failure.				

Table 4--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Blachman, Ball, Black, & Tangel (1994)	N = 159 Kindergarten (average learners)	Segmentation Letter names and sounds WJ-R Word Identification Word Attack Word Reading Spelling	Group 1. Segmentation and letter sound practice Group 2. No intervention	15-20 minute sessions 4 sessions per week 11 weeks
Results: Group 1 gained significantly over Group 2 on all measures except the WJ-R Word Attack Subtest (Group 2 read more nonwords than Group 1).				
Limitations: Assignment to groups was not strictly random.				
Byrns & Fielding- Harnsley (1991)	N = 126 Age 5 (average learners)	Phoneme identification tasks Letter-sound recognition Word reading	Group 1. Identification of phonemes and letter-sound practice Group 2. Story reading, semantic categorization games	25-30 minute sessions 1 session per week 12 weeks
Results: Significant overall increases in PA and reading. Group 1 had greater gains than control.				

Table 4--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Castle, Riach, & Nicholson (1994)	<u>Experiment 1</u> N = 30 Age 5	<u>Experiment 1</u> Phonological Awareness tasks, WRAT, spelling words, dictation, written vocabulary, letter knowledge	<u>Experiment 1</u> Group 1. Segmentation, deletion, substitution, rhyme, letter- sound practice Group 2. Process writing with invented spelling	<u>Experiment 1</u> 20 minute sessions 2 sessions per week 10 weeks
	<u>Experiment 2</u> N = 51 Age 5 (both groups were below average in phonological awareness)	<u>Experiment 2</u> Phonological Awareness tasks, letter knowledge, word reading, pseudo words, dictation, written vocabulary, print concepts	<u>Experiment 2</u> Group 1. Segmentation, blending, alliteration, rhyming, deletion, letter-sound practice Group 2. Meaning-based instruction (categorizing semantic cues, letter names only, listening to stories	<u>Experiment 2</u> 20 minute sessions 1 session per week 15 weeks

Results: Experiment 1: Greater effects for Group 1 on PA measures and WRAT spelling.
Experiment 2: Significant Group 1 effects for all measures.
Limitations: Control group had higher cognitive skills. Effects were small.

Table 4--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Defior & Pio Tudela (1994)	N = 55 Age 6 Spain (low PA)	Phoneme discrimination Reading Writing Mathematics	Group 1. Categorization of words based on phonemes Group 2. As above but including the use of plastic letters Group 3. Categorization of words based on concepts Group 4. As for Group 3 but including written words as and aid Group 5. No intervention	90 minute sessions 1 session per week 20 weeks
Results: Significant effects on reading, decoding, and writing measures for Group 2 when compared with all other groups. Effects were maintained at follow-up assessment 2 months later.				
Haskell, Foorman, & Swank (1992)	N = 48 Grade 1 (average learners)	Word lists	Group 1. PA activities at phoneme level Group 2. PA activities at onset-rime level Group 3. Whole-word instruction (meaning based) Group 4. No intervention	20 minute sessions 2 sessions per week 6 weeks
Results: Those taught PA at the onset rime and phoneme level performed significantly better on reading measures than those taught with the whole word method or those given no intervention. There was no significant difference in performance between Group 1 and Group 2.				

Table 4--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Hohn & Ehr1 (1983)	N = 24 Kindergarten Age 6 (nonsegmenters)	Segmentation Deletion Decoding	Group 1. Segmentation using letter tokens Group 2. Segmentation using blank tokens Group 3. No intervention	20 minute sessions 5 sessions per week
Results: Significant effects for Groups 1 and 2 on all PA measures. No significant differences were noted on reading measures.				
O'Connor & Jenkins (1995)	N = 10 Kindergarten Age 5-6 (developmental delays)	Blending, segmentation Spelling WRMT Word Identification WRMT Word Attack	Group 1. Segmentation and letter-sound practice (spelling with magnetic letters and writing words) Group 2. Reading words only	10 minute sessions 20 sessions
Results: Group 1 made significant gains over Group 2 in word identification and spelling real words and nonwords. No differences in segmentation or blending.				
Limitations: Small N. Subjects probably had segmenting and blending ability greater than usual for kindergarten due to phonics-based reading curriculum.				

Table 4--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
O'Connor, Jenkins, & Stocum (1995)	N = 67 (Kindergarten language delays, Exceptional Student Education (ESE) identified and ESE referred)	Rapid letter naming Syllable deletion Rhyme production Segmentation, Blending Letter-naming Word identification LAC, Reading analog trials	Group 1. Segmentation and blending combined with letter sound practice Group 2. Global PA activities combined with letter sound practice Group 3. Letter-sound practice Group 4. No intervention	15 minute sessions 2 sessions per week 10 weeks
Results: No differences were reported between Groups 1 and 2 on PA skills or a reading analog test. Both performed better than the letter-sound only group.				
Olofsson & Lundberg (1983)	N = 95 (Kindergarten Age 6-11 (Sweden) (below average in phonological awareness and reading)	Researcher-developed phoneme synthesis and phoneme analysis, and reading measures	Group 1. Rhyming, segmentation, phoneme identification, deletion, blending, letter-sound practice Group 2. Nonverbal sound discrimination Group 3. Traditional preschool program	30 minute sessions 3-4 sessions per week 6-8 weeks
Results: Only Group 1 showed significant improvement across tasks. Limitations: Nonrandom assignment. Normality assumption violated. Ceiling effects.				

Table 4--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Tangel & Blackman (1992)	N = 149 Age 5-6 (average learners)	Phoneme segmentation Letter names WJ-R Word Identification Reading phonetically regular words Reading phonetically regular nonwords Developmental spelling	Group 1. Say it/move it (Elkonin task) segmentation, other segmentation, letter-sound practice Group 2. No intervention	15-20 minute sessions 4 sessions per week 11 weeks
Results: Group 1 significantly outperformed the control group on phoneme segmentation, letter names, sound knowledge, word and nonword reading, and developmental spelling.				
Vellutino & Scanlon (1987)	N = 300 Grade 2 (average learners) and Grade 6 (those with Specific Learning Disabilities)	Pseudoword decoding test Phonemic segmentation ability test Response acquisition measures (recall) Word identification (code acquisition)	Group 1. Phonemic segmentation, letter-sound practice Group 2. Response association Group 3. Both treatments combined Group 4. No intervention--Grade 2 Group 5. No intervention--Grade 6	30 minute sessions 2 weeks
Results: Groups 1 and 2 made significantly higher gains than Groups 2 and 4 on all measures.				

instruction to a total of more than 300 kindergarten children. Each intervention took place 4 times a week over a period of 11 weeks. These children were compared with those who received no specialized training in phonological awareness. The researchers used a "say-it-and-move-it" segmentation task, modeled after Elkonin's (1973) similar activity. In this segmentation activity, children moved colored disks from the top of a laminated card to the bottom half to represent the sounds they heard in words. Letters were put on the tiles of those children who had mastered both the name and sound of the letter. Children could use a combination of letter tiles and blank tiles, or they could use all blank tiles to segment a word. Other segmentation-related activities included categorizing groups of pictured words by rhyme or alliteration. Cards were placed on a table, and the children pointed out the one that did not rhyme with the others or did not begin with the same initial sound. Results of the Blachman et al. (1994) study indicated significant positive effects for the segmentation group on a test of segmentation and positive effects for reading on the Word Identification subtest of the Woodcock-Johnson Achievement Tests-Revised (Woodcock & Johnson, 1989, 1990). Results of the Tangel and Blachman (1992) study indicated significant positive effects for the segmentation group on a test of segmentation, two measures of reading (phonetically regular words and nonwords), and a test of developmental spelling.

Though positive effects on phonological awareness and reading were found in both of these studies, the Ball and Blachman (1991) study has been criticized because the blending training some of the children may have received in their regular classroom instruction would have confounded the effects of the phonological intervention (Davidson & Jenkins, 1994). If such were the case, the positive effects of the intervention may have been the result of blending-plus-segmentation training rather than segmentation alone. Such a limitation was avoided by Byrne and Fielding-Barnsley (1991), who taught phoneme identification to 126 kindergarten children for 12 sessions. Reading was measured by matching an auditory stimulus to a printed word ("Does this say sat or mat?"). In such a task, blending skill would not be a factor because only the correct identification of the initial phoneme would be required. Significant overall increases were reported in phoneme identification and reading.

Other interventions have consisted of teaching more than a single phonological task combined with letter-sound training (Alexander, Anderson, Heilman, Voeller, & Torgesen, 1991; Ball & Blachman, 1991; Castle, Riach, & Nicholson, 1994; Haskell, Foorman, & Swank, 1992; Hohn & Ehri, 1983; O'Connor & Jenkins, 1995; O'Connor, Jenkins, & Slocum, 1995; Olafsson & Lundberg, 1983). These studies included segmentation and blending instruction, sometimes combined with instruction in other phonological skills. For example, O'Connor et al. (1995) sought to determine the breadth of

phonological awareness instruction necessary to increase the phonological skills of kindergartners at risk for reading failure. The study included a low phonological awareness group (language delayed, special education, or special education referred students) and a high phonological awareness group (average learners). The 67 children in the low phonological awareness group were divided into three treatment groups. One group received blending and segmentation plus letter-sound instruction. The second group received the same instruction with the addition of tasks such as syllable deletion and rhyming. The third group received letter-sound training only. Results indicated no significant differences for the group taught phonological skills only and the group taught phonological awareness skills plus letter-sound correspondence on the Lindamood Auditory Conceptualization (Lindamood & Lindamood, 1979) test and a reading analog test. Both performed significantly better than the letter-sound-only group. The authors concluded that learning segmentation and blending provide enough base to transfer to broader phonological awareness. Teaching additional phonological awareness skills may not be necessary.

A major weakness of most of the studies combining phonological training and letter-sound practice is that none included a group that received phonological training alone. No conclusion about the relative effectiveness of phonological training with and without the letter-sound

component can be drawn from this research. A well-designed study that did include a phonological-skills-only group (Hohn & Ehri, 1983) was conducted with 24 kindergarten children. One group used letter tokens to practice segmenting words. A second group practiced the same skill with blank tiles. The study resulted in significant effects for the letter token group for segmentation skill but no significant differences in the two groups for decoding nonwords. The authors concluded that using letters facilitates segmentation instruction but does not enable kindergartners to decode nonwords (blend). The Defior et al. (1994) study also compared groups taught phonological awareness with and without letter-sound instruction. The study took place in Spain with 55 age 6 subjects. Significant effects for the letter-sound group on all measures were noted.

Summary of studies combining phonological and letter-sound training. Overall, the results of studies that have used the phonological plus letter-sound combination training have been positive. Significant increases in phonological awareness skills have been reported for children in these treatment groups when compared with children engaged in other language activities or those given no extra instruction. Because few of these studies have included a phonological-skills-only treatment group, it is difficult to draw conclusions about the relative effectiveness of phonological skills training with and without the addition of letter-sound practice. A study that did make such a comparison (Hohn &

Ehri, 1983) found no significant differences between groups on reading measures. A second study making the same comparison (Defior et al., 1994) found significant effects for the letter-sound group.

Contextual application of phonological skills. There is evidence suggesting that phonological skills taught within the context of reading-connected text is effective for some children (Cunningham, 1990; Hatcher, Hulme, & Ellis, 1994; Lane, 1994; Vandervelden & Siegel, 1995; Weiner, 1994). Table 5 summarizes this research. In Cunningham's (1990) study, children in kindergarten and first grade received explicit instruction in the application of phonological awareness skills and discussed how and when to use the skills while reading stories. They were compared with a group taught phonological awareness skills by the isolated skills practice method. These children received no instruction within the context of reading. Both groups displayed a significant improvement in reading achievement; however, the degree of improvement of the first-grade participants depended strongly upon the type of instruction received. The children who were helped to think about the value of phonological awareness skills and their application to reading performed better on a transfer measure of reading achievement than those who received no contextual application.

The relative effects of phonological awareness skills training combined with reading instruction were compared with

Table 5

Studies Training Contextual Application of Phonological Skills

Study	Subjects	Dependent Measures	Intervention	Duration
Cunningham (1990)	N = 84 42 Kindergarten Age 6 42 Grade 1 Age 7 (average learners)	Phoneme deletion Phoneme oddity LAC Metropolitan Achievement Test (MAT)	Group 1. Metalevel segmentation & blending with explicit application (discussed how and when to use skills in story) Group 2. Skill and drill segmentation and blending (implicit application-no application in reading context) Group 3. No intervention	15-20 minute sessions 2 sessions per week 10 weeks

Results: Significantly greater positive effects for Group 1 when compared to Groups 2 and 3. For Group 1, grade 1 subjects were significantly higher than kindergarten subjects on deletion and a transfer measure of reading achievement.

Table 5--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Hatcher, Hulme, & Ellis (1994)	N = 124 Age 7 (United Kingdom) (below average reading skills)	Sound deletion Nonword segmentation Sound blending Sound categorizing Word & text reading Spelling	Group 1. Reading with letter-sound practice and PA activities Group 2. Reading with letter-sound practice--no PA activities Group 3. PA activities alone--no letter-sound practice or reading application Group 4. No intervention	30 minute sessions 40 sessions 25 weeks
Results: Those taught PA in the context of reading (Group 1) performed significantly better than all other groups on reading and spelling measures. At a follow-up assessment 9 months later, reading gains were maintained, but spelling gains tended to diminish.				
Lane (1994)	N = 43 Grade 1 (below average phonological awareness)	Elision Sound Matching Blending Segmentation Decodable words and nonwords Reading fluency Reading comprehension	Group 1. Instruction in PA skills with contextual application Group 2. Instruction in PA skills without contextual application	30 minute sessions 18 sessions 8 weeks
Results: When Group 1 and Group 2 were divided into levels according to reading fluency pretest scores, significant differences were noted on measures of total phonological awareness and reading comprehension for those children with very low fluency on the pretest.				

Table 5--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Vandervelden & Siegel (1995)	N = 30 Kindergarten Age 5-6 (22 with below average phonological awareness)	Phonological recoding tasks Speech-to-print matching Invented spelling Nonword reading PA and letter tasks Phoneme awareness (auditory recognition) Deletion Substitution Letter naming Letter-sound correspondence Reading tasks Word learning Word reading Finger-point reading Key-word reading	Group 1. Segmentation activities Spelling practice Reading practice Guidance in using letter-sound & PA knowledge to read and spell Group 2. As above but no guidance in application of PA or letter- sound knowledge to read and spell	30 minute sessions 2 sessions per week 12 weeks

Results: Group 1 gained significantly compared to Group 2 on all measures. Group 2 had significant gains on only one measure (finger-point reading of text).

Table 5--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Weiner (1994)	N = 75 Grade 1 (low achieving & middle achieving)	Segmentation Deletion Substitution Reading decoding Gates-MacGinitie Reading Test Oral reading assessment	Group 1. Segmentation, blending, substitution--no letter- name or sound practice Group 2. As above but followed by decoding practice (no explicit training for con- necting PA skills with decoding activity) Group 3. Conceptual (Group 2 intervention plus explicit instruction on how to apply skills in text reading)	25 minute sessions 2 sessions per week 6 weeks

Results: No significant differences among groups on measures of phonological awareness or reading. For the lowest-ability subjects only, conceptual training (application in the context of reading as for Group 3) was the least effective intervention.

the effects of reading instruction alone and phonological awareness instruction alone (Hatcher et al., 1994). Groups of children (N=124) matched on age, reading ability, and IQ. Training of phonological awareness in the context of reading produced strong positive effects on measures of spelling and word reading. Nine months later, the effects on reading were still in evidence, though beginning to show a diminishing tendency. Vandervelden & Siegel's (1995) study with children with low phonological awareness resulted in significant progress for children who received contextual instruction for one group but no practice in context for the second group. Results indicated significant progress for the group taught within the context of reading when compared to the group who received no contextual instruction.

In Lane's (1994) study, data analysis revealed that for the lower achieving children, those who practiced skills within the story context made significant gains on two measures, total phonological skills and reading comprehension, compared to those taught with no contextual application.

Weiner (1994) compared 23 low-achieving and 52 middle-achieving first-grade students to determine their responses to training that included contextual application of phonological skills. In contrast to the findings of Cunningham (1990) and Hatcher et al. (1994), Weiner's

research indicated that training providing children with a conceptual connection between phonemic skills and reading was generally ineffective for low readers.

Summary of the Content of Phonological Awareness Instruction

Phonological awareness training has been implemented with beginning readers in an attempt to make them consciously aware of the segmental nature of language and to help them gain some facility in the manipulation of the sound components that make up language. A review of the literature reporting these studies suggests the most frequently included tasks were (a) segmentation, (b) blending, and (c) rhyming. Less frequently included tasks were (a) deletion, (b) phoneme identification, and (c) phoneme substitution.

Phonological awareness training has consistently increased phonological awareness skills and reading performance. This result has held constant whether the phonological tasks were taught alone or in combination with letter-sound instruction. Though some studies (Ball & Blachman, 1991; Hohn & Ehri, 1983) indicated the importance of letter-sound instruction, such training does not seem to be crucial to successful intervention. Clearly, phonological instruction alone can be effective in increasing phonological skills and reading skills measured by real or nonword reading (Davidson & Jenkins, 1994; O'Connor et al., 1993; Slocum et al., 1993; Torgesen et al., 1992). The children in the present study demonstrated letter-sound knowledge on an

invented spelling task administered prior to the pretest battery, and letter-sound instruction was not considered necessary to the design of this intervention.

In this review of phonological training studies, critical skills that must be taught to increase phonological awareness and reading skill have been identified. There is additional evidence suggesting the method of instructional delivery that has been most effective in teaching these skills. In the following section the characteristics of direct instruction are discussed.

Direct Instruction and Phonological Awareness

A previous review of phonological training studies (Smith, Simmons, & Kameenui, 1995) reported that conspicuous strategies (sequences of teaching events and teacher actions that make explicit the steps required to hear and manipulate sounds) were present in all interventions. Smith et al. suggested the following components of successful instruction in phonological awareness skills:

1. Explicit instruction in which phonological skills are directly and overtly taught and practiced. Instruction in phonological skills must be systematic, structured, and taught to mastery.
2. Demonstration, modeling, and guided practice. Tasks should be modeled by the teacher and practiced over time to make the blending and segmenting processes obvious and automatic. Corrective feedback should be provided.

The instructional variables described by Smith et al. (1995) are characteristic of direct, systematic instruction. Results of the more exhaustive review undertaken for the present study corroborate these findings. In all studies where instruction in phonological awareness resulted in significant increases in phonological and reading skills, elements of direct, explicit instruction were present. Furthermore, several experimental studies have compared the effects of the direct instruction method with another method of instruction on the phonological awareness skills of children. In the following section, these studies are reviewed.

Experimental Evidence for the Efficacy of Direct Instruction

Additional evidence supporting the efficacy of the direct instruction method in teaching phonological skills was provided by several studies comparing other methods of instruction with the direct instruction method (Castle et al., 1994; Felton, 1993; Foorman et al., 1991). Castle et al. (1994) compared children taught segmentation, deletion, substitution, rhyming, and letter-sound correspondence with those taught a process writing activity using invented spelling. The writing activity included planning, editing, and publishing creative compositions. The invented spelling component involved using letters to represent the sounds heard in words. Results indicated greater effects for the direct instruction group on phonological awareness measures

and spelling measured by the WRAT (Jastak & Jastak, 1978). In a second experiment, children were explicitly taught segmentation, blending, alliteration, rhyme, deletion, and letter-sound correspondence and compared to those taught by a meaning-based approach (categorizing, semantic cues, letter names, listening to stories). Results showed significantly superior effects for the direct instruction group on measures of phonological awareness, letter knowledge, word reading, pseudowords, dictation accuracy, writing vocabulary, and print concepts.

In a 2-year study, Felton (1993) sought to determine how children with phonological processing deficits respond to code versus context reading instruction. Children at risk for reading failure (N=48) were randomly assigned to treatment groups. In a second experiment children at risk (N=65) were placed in treatment groups by matching for the extent of their phonological processing deficits. Results of both experiments indicated higher means for the code group for all measures (including the Word Attack and Word Recognition subtests from the Woodcock Reading Mastery Test-Revised (Woodcock, 1987)).

Training study reviews provide evidence that the direct instruction approach has been successful in increasing children's phonological awareness and reading skills. Within-study comparisons of direct instruction in phonological awareness to other instructional methods corroborate these findings. Such evidence supports

interventions that provide explicit instruction in phonological awareness to children deficient in these skills. In the following section, the characteristics of direct instruction are discussed.

Characteristics of Direct Instruction

Direct instruction variables include engaged time, frequent responding, immediate feedback, and error correction (Rosenshine, 1976). As practiced, direct instruction often incorporates principles of systematic instruction, including identifying goals and objectives, breaking down tasks into simplified units, carefully sequencing units to accomplish the learning goal, and providing systematic assessment to evaluate instruction (Spiegel, 1992). In direct instruction, students are focused on what is to be learned and explicitly taught how to do a particular process through teacher modeling and explanation. This instruction is followed by guided practice as students are given assistance in performing skills. Independent practice takes place with relevant materials until mastery of the skill is achieved. Throughout direct instruction, assessment provides data that inform decision-making for instructional change. Direct instruction is based on providing enough sustained, focused practice to enable learners to use skills and strategies effectively.

Direct instruction is conceived as a carefully sequenced curriculum (Sexton, 1989). Teachers present information, usually guided by a prepared script. Students repeat the

information. Teachers ask questions. Students respond. The teacher praises appropriate responses or offers corrective feedback for incorrect responses. The process is repeated until the children can respond correctly. At that point, instruction advances to the next sequence.

Summary of Direct Instruction and Phonological Awareness

Training study evidence provides support for including elements of direct instruction in interventions designed to increase phonological awareness skills. The components of direct instruction have been well defined in the professional literature. Implementing such instruction may be difficult for teachers in the general classroom, however. Challenges teachers face in providing such instruction are discussed in the following section.

Barriers to Delivering Direct Instruction in General Classrooms

Though research supports the use of direct instruction methods to teach phonological awareness, barriers exist to providing such instruction in the general classroom. First, conflicts in philosophy lead to disagreement about the way instruction should be delivered in elementary classrooms. Second, lack of teacher time, insufficient training, and untested materials limit the ability of the teacher to deliver direct instruction. Finally, the influence of school culture affects teachers' planning of instructional

accommodations for individuals and subgroups at risk for school failure.

Philosophical conflicts. Conflicts in philosophy concerning reading instruction have centered around the debate concerning whole language versus code emphasis approaches to literacy. Given the generally acknowledged fact that phonological awareness facilitates acquisition of the alphabetic code and that phonological knowledge can be assessed accurately, it appears logical to pursue interventions to increase the phonological skills of students at risk for reading failure. Much controversy exists, however, over how these skills are to be taught to young students. Though the emphasis in whole language classrooms on the integration of speaking, listening, reading, and writing has increased early literacy experiences, a significant number of students do not learn to read simply by being exposed to language. The missing element is direct instruction in phonological knowledge and decoding skills (Blachman, 1993; Mather & Roberts, 1994). While whole language proponents may advocate phonics instruction on an "as needed" basis, a systematic, ongoing assessment of these skills is often absent from whole language classrooms. Teachers may depend on their observational skills (Adams, 1990). Thus, it is improbable that every student gains adequate instruction in the alphabetic code. Those students already at risk because of lack of early literacy experiences or learning disabilities may fail to learn to read.

Pressley and Rankin (1994) compared learning to read with learning to play baseball. Students can learn by playing the game, but honing individual skills is best accomplished by direct instruction during practice sessions. It is difficult to imagine learning any activity involving discrete skills without the benefit of direct instruction. Though possible for some learners, those without natural aptitude will be at a disadvantage. This is precisely what happens when we fail to provide instruction to students about the segmented nature of spoken words and how sound segments in spoken words map onto individual letters of the alphabet. This is not to say whole language methods are bad or that whole language classrooms should be abolished. On the contrary, research supports a balanced approach which combines both whole language and code-oriented instruction (Vellutino, 1991).

In support of the balanced approach to instruction, a continuum of teaching methods was proposed (Mercer, Lane, Jordan, Allsopp, & Eisele, 1996). This model illustrated how instruction can be conceptualized as a range of choices from explicit, teacher-controlled learning to implicit, student-regulated approaches. The authors suggested that methods of instruction ranging from those based strictly on behavioral principles to the discovery learning characteristic of whole-language classrooms can be appropriate. Educators must consider the needs of students and the nature of content before making instructional choices for individual learners.

Implications of the balanced approach for instruction in diverse classrooms include a rich variety of literacy experiences combined with explicit instruction in letter-sound correspondence. Within this context, instruction in phonological skills should be provided for children who lack sufficient phonological awareness to make sense of letter-sound instruction. Direct instruction in both phonological awareness and phonics must be provided on a consistent basis. Ongoing assessment must ensure that skills are taught to the mastery level.

Issues of time, training, and materials. Torgesen and Barker (1995) discussed the difficulties teachers may encounter in providing appropriate instruction in phonological awareness for children at risk for reading failure. Providing consistent direct instruction that is well planned, interactive, and closely monitored requires teacher time spent in planning and managing instruction for children who may represent only a small percentage of the total classroom group. Even when time can be found to implement such instruction, children do not necessarily master skills as a group. Teachers may not wish to hold back a group until every child has mastered each skill. To do so is limiting to children who learn at a faster rate. Providing for the needs of children who learn at slower rates can be difficult in diverse classrooms. Furthermore, paraprofessionals, volunteers, and other personnel who might

be available to provide help to teachers may not have received training in this kind of intervention.

There are other problems in providing direct instruction on a consistent basis. Lessons must encourage frequent responding and provide adequate amounts of feedback for each child. Motivational factors play an integral role in children's learning and must be considered. Direct instruction in basic skills can seem repetitive and boring unless lessons are engaging, interactive, and varied. Such lessons require planning time for gathering and preparing appropriate materials as well as consistent enthusiasm on the part of the teacher. An effective behavior management system must often be in place with adequate planning devoted to providing meaningful activities for the students in the classroom who do not need instruction in phonological awareness.

An additional factor is the necessity for effective data management. The effectiveness of instruction in phonological awareness must be observed ongoingly; data must be recorded; and progress must be assessed. From this assessment, individualized instruction that matches the learning needs of each child can be implemented. A system of data management requires time to design, implement, and maintain. Yet, it is essential to track children's progress in order to provide effective and efficient instruction.

Such factors are principles of effective instruction that most teachers are aware of and try to include in their

classroom instruction. However, implementing such instruction for a small group of children within the regular classroom requires an additional expenditure of time and materials that the already overcommitted teacher may not be willing or able to invest.

The influence of school culture on teacher planning. In a special issue of Effective School Practices, the Joint Committee on Teacher Planning for Students with Disabilities (1995) summarized 4 years of research across four projects sponsored by the Office of Special Education and Rehabilitative Services under the initiative of "Research on General Education Teacher Planning and Adaptation for Students with Handicaps." The results of this research on teacher planning in America's schools explain some of the problems associated with meeting the needs of students with disabilities in general education classrooms. These problems are applicable to planning instruction for students with deficient phonological awareness skills. The following statements from the Joint Committee report describe how teachers plan for student learning in diverse classrooms.

1. Planning is focused on group learning.
Instructional approaches most often center around whole-class activities.

2. Individual accommodation frequently conflicts with the goals of group instruction. Teachers do not have time to plan or implement accommodations for individuals or subgroups in the classroom.

3. Teachers often plan for the group by planning for the "one." Teachers plan for a "meta-student" who represents the characteristics of many students encountered across their careers. This hypothetical student is often an above-average performer.

4. Teacher planning is characterized by efficiency and economy. Plans focus on what must be accomplished rather than the more difficult question of learning failure.

5. Teachers are not sure how to plan for students with disabilities. Teachers believe they do not have the necessary competencies to plan for and teach students with disabilities.

6. Activities are chosen for their attractiveness to students. Methods adopted to meet the needs of diverse learners are frequently abandoned when they are perceived as nonmotivating to higher-achieving students, even when such methods have been effective in enhancing the learning of these students.

7. Planning centers on how students will spend their time. Planning books contain references to activities to be conducted, pages to be covered, and assignments to be given. References to accommodations for individual students are rare.

8. Most teachers plan units rather than lessons. Teachers talk most about unit goals. Less attention is given to individual lesson goals. Lesson plans are rarely altered to accommodate individuals or small groups.

Summary of barriers to delivering direct instruction in general classrooms. Barriers exist to providing direct, explicit instruction in general classrooms. Conflicts in philosophy lead to disagreement about the way instruction should be delivered. Lack of teacher time, insufficient training, and untested materials limit the ability of the teacher to deliver such instruction. The influence of school culture affects teachers' planning and instruction of individuals and subgroups at risk for school failure. Fortunately, there is potential for computer-assisted instruction to help teachers overcome some of the difficulties in delivering direct instruction to children at risk for reading failure because of delayed development of phonological skills.

The Potential for Computer Assistance to Overcome Barriers to Direct Instruction

Though problems exist in providing direct, explicit instruction in general classrooms, computer-assisted instruction can help teachers overcome these barriers. Computers can provide explicit instruction in whole language classrooms for children who have difficulty learning skills inductively. Computer assistance offers alternatives when lack of time, training, and appropriate materials present difficulties in delivering instruction. Computer instruction can also help ameliorate the influence of school culture that affects teachers' planning and instruction for individuals and subgroups at risk for school failure. The following

sections highlight the characteristics of computer-assisted instruction that can help teachers overcome barriers to delivering direct instruction in diverse classrooms.

The Match Between Direct Instruction Methods and the Characteristics of Effective Computer Programs

The characteristics of effective computer programs interface well with principles of direct instruction. In direct instruction, teachers use modeling, explanation, and guided and independent practice to make explicit to students how a particular process can be performed. Direct instruction incorporates ongoing assessment and instructional change based on assessment data. Instructional variables include engaged time, frequent responding, and immediate feedback and error correction (Rosenshine, 1976).

Characteristics of effective software programs are (a) sufficient degree of learner control, (b) adequate and appropriate feedback, (c) on-going data management, (d) effective use of graphics, and (e) integrated motivation enhancement (Larsen, 1995). These characteristics interface with the characteristics of direct, explicit instruction in the following manner.

Sufficient degree of learner control. The ability of the student to interact with the computer ensures "engaged time" and frequent responding, two important direct instruction variables. In an interactive program, each stroke of the keyboard or click of the mouse will elicit as few events as possible in order to keep the student

frequently and actively engaged (Geoffrion & Geoffrion, 1983). Ideally, students also will have some control of the "directive" force. For example, the DaisyQuest (1993) and Daisy's Castle (1993) computer programs require frequent clicks of the mouse to choose areas and rooms of the castle where different skills will be practiced. If students are unresponsive to cues for their input, the wizard/instructor begins to snore audibly. The student is thus prompted to attend to the task. As often as needed, students can click on stimulus pictures for pronunciation by the computer. In the tutorial and practice format, student responses elicit positive reinforcement or corrective feedback. In effective programs, control is balanced between the program and the learner.

Adequate and appropriate feedback. Immediate corrective feedback is an important component of direct instruction and an integral aspect of computer learning (Balajthy, 1989). Larsen (1995) asserted that feedback must consist of more than whether responses are correct or incorrect. In order to include a directional dimension of learner control, feedback should consist of corrective cues and information about why a response is wrong and how it can be changed. Larsen suggested that one of the greatest advantages of using a computer program is its ability to provide consistent and immediate directional and corrective feedback.

On-going data management. A salient aspect of effective direct instruction is frequent assessment of progress and

changes in instruction based on such data. Computer programs can store performance or evaluation data necessary for the documentation of student progress (Balajthy, 1989; Hasselbring, 1991). Longitudinal student-performance data allow teachers to make informed decisions based on an individual student's progress. Programs based on the concept of mastery learning can provide instantaneous feedback and identify and reward correct responses while also maintaining complete records of pupil performance. Such information informs teachers who wish to select appropriate teaching sequences for individuals (Barker & Torgesen, 1995; Spencer, 1996).

Effective use of graphics. Direct instruction for prereaders must necessarily rely on illustrations to reinforce auditory learning. These elements can be an important factor in delivering instruction that is engaging and motivating. Computer graphics presented as an integral part of the learning content also reinforce learning and enhance retention.

Integrated motivational factors. In direct instruction, positive feedback for correct responding ensures built-in motivation for students. Computer-assisted instruction is characterized by three kinds of motivational factors: (a) unintegrated extrinsic rewards, (b) integrated extrinsic rewards, and (c) intrinsic interest (Larsen, 1995). Examples of unintegrated extrinsic rewards are smiling faces or points given to the student or appearing on the screen when correct

answers are given. Integrated extrinsic rewards are most often seen in the game-like format which features students competing with themselves or others. In the DaisyQuest (1993) and Daisy's Castle (1993) computer programs, students earn clues to solving a puzzle when they master skills. Intrinsic motivation is based on achieving meaningful personal goals rather than external incentives. While intrinsic motivation may be most desirable, integrated extrinsic rewards can be effective in increasing student motivation.

Summary of the Potential for Computer-Assistance to Overcome Barriers to Direct Instruction

The preceding sections have highlighted characteristics of effective computer-assisted instruction. The match between direct instruction methods and the characteristics of effective computer programs can help teachers overcome barriers to meeting the needs of children at risk for reading failure. Computers can provide explicit instruction in whole language classrooms; solve problems related to lack of time, training, and materials; and counteract the negative influences of school culture.

Training study evidence indicates that computer-assisted instruction has been effective in increasing children's reading skills. In the following section, selected training studies assessing the effectiveness of computer-assisted instruction in the area of reading are examined. These studies were chosen for discussion because they represent

trends in computer-assisted reading instruction over the past 10 years.

Computer-Assisted Instruction and Reading Intervention

Children with identified reading disabilities have most often been the subjects of computer-assisted reading instruction. For these students, computer instruction has been examined in the areas of decoding (Jones et al., 1987; Roth & Beck, 1987; Spencer, 1996; Torgesen & Barker, 1995; van Daal & Reitsma, 1990; Wise & Olsen, 1994), reading-connected text (Torgesen & Barker, 1995; Leong, 1995; Wise & Olsen, 1994), comprehension (Leong, 1995), and spelling (Olson & Wise, 1992).

Based on the theory that comprehension is highly dependent on fast and accurate word reading (Perfetti, 1985), a substantial body of research has been devoted to increasing fluent and accurate decoding skills. Roth and Beck (1987) used two word recognition programs with 108 low-performing fourth-grade students. The students were from low socioeconomic backgrounds. In the Construct-A-Word program (Beck & Roth, 1984a), students matched consonants or consonant clusters with phonograms to create whole words. Digital speech provided feedback for the task. In the Hint and Hunt program (Beck & Roth, 1984b), students matched a spoken version of a word or pseudoword to a visual one. Both programs used a game format in which points could be earned for speed and accuracy of response. Students used the programs three times a week for 8 months, a total of

approximately 10-12 hours of instruction for each program. Results of the study showed substantial increases in word recognition and decoding skills and improvements in comprehension at the word and sentence level. No improvement at the passage comprehension level was noted.

An additional study evaluated the Hint and Hunt (Beck & Roth, 1984b) program with 20 students with learning disabilities (school-identified) in first through seventh grade (Jones et al., 1987). Students were given 15-minute daily practice sessions for 10 weeks, a total of approximately 12 hours of instruction. Children in the experimental group showed significant improvements on words directly practiced in the program and on generalization words not practiced during the training. Improvements in speed and accuracy occurred for both context-free word reading and oral reading of connected text.

More recently, research has focused on maximizing the effects of speech feedback. Researchers have investigated the effects of different types of feedback that can be delivered via the speech component. In a study of 31 children (mean age 9.9) from special education schools, three conditions for independent practice with a word recognition program were compared (van Daal & Reitsma, 1990). Two groups were allowed to choose whole-word or segmented feedback. A control group received no feedback. Results indicated both forms of speech feedback were equally effective in reading practiced words. There was a nonsignificant tendency for the effectiveness of

segmented feedback on nonpracticed words. A weakness of the study was the nonrandom assignment of students to groups.

This line of research was continued in the studies done with DECTalk (Digital Equipment Corporation), a speech synthesizer (Olson & Wise, 1992; Wise & Olson, 1994). In this program, children with reading problems read stories and books on talking computers for about 30 minutes a day, 3-4 days per week for most of a semester. The students' word recognition improved compared to the skills of students who received only regular classroom language arts instruction. Results comparing whole-word and segmented feedback were inconsistent. With the DECTalk spelling program, results were also inconsistent, but training did lead to a marginally significant advantage in spelling the trained words for at least one group.

In further work with DECTalk, researchers investigated whether comprehension of connected text can be facilitated by computer-assisted instruction. Leong (1995) completed two studies with above- and below-average readers in fourth through sixth grades. Some children read passages while being given feedback with explanations of difficult words. Others were given feedback without these explanations. Reading comprehension was assessed from verbal answers to inferential questions and verbal summaries of the passages. No significant differences across four conditions were reported in either study.

An additional trend in the computer-assisted instruction developed for word recognition was the incorporation of direct, systematic instruction principles in these programs (Spencer, 1996). Components such as instantaneous feedback to identify and reward correct responses and set criterion levels for progression from one task to the next provided frequent opportunities for children to respond and immediate error correction. They also provided complete records of performance, allowing teachers to individualize instruction for each student.

In summary, it is clear that computer-assisted instruction has been successful in increasing the word recognition skills of children with reading problems, though effects on spelling and reading comprehension have been inconsistent. Trends toward the successful use of computerized speech feedback and direct instruction principles are evident. Additionally, some trend toward providing feedback at the phoneme level has been noted (van Daal & Reitsma, 1990; Wise & Olson, 1994), though results in this line of research have also been inconsistent. In the following section, training studies employing computer-assisted instruction in phonological awareness are discussed.

Computer-Assisted Instruction and Phonological Awareness

Table 6 summarizes the intervention studies using computer-assisted instruction to increase phonological awareness skills. Computer-assisted instruction in

Table 6

CAI in Reading and Phonological Awareness

Study	Subjects	Dependent Measures	Intervention	Duration
Barker & Torgesen (1995)	N = 54 Grade 1 (below average readers)	Computer PA Test Sound categorization Blending Segmentation Elision WRMT-Word Attack WRMT Word Identification Nonword Efficiency Test Real Word Efficiency Test Stanford Binet vocabulary	Group 1. DaisyQuest & Daisy's Castle (rhyming, blending, segmentation) Group 2. Hint & Hunt (vocabulary) Group 3. Math program (attentional control group)	25 minute sessions 4 sessions per week Total 8 hours

Results: Group 1 made significantly higher gains on a computerized test of PA skills, segmentation, and elision. Group 1 was significantly higher on WRMT Word Recognition. No significant effects for nonword reading.

Table 6---continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Baron et al. (1992)	N = 66 Kindergarten Age 5-7	Oddity Rhyme Deletion WMAT-Word Attack WMAT Word Identification Letter-sounds	Group 1. Oddity tasks (PA) with speech & print feedback Group 2. Oddity tasks (PA) with speech only feedback Group 3. Oddity tasks (semantic categorization)	Total 3 hours

Results: For Groups 1 and 2, children with less letter-sound knowledge showed gains on rhyming regardless of type of feedback. For Group 2, those high on letter-sound knowledge gained significantly on deletion compared to Groups 1 & 3. There were only nonsignificant differences in Word Attack, Word Identification, and letter-sound knowledge.

Table 6--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Foster, Erickson, Foster, Brinkman, & Torgesen (1994)	<u>Experiment 1</u> N = 27 Age 5-6 (below average PA)	<u>Experiment 1</u> Phonological Awareness Test (PAT) Screening Test of Phonological Awareness (STOPA)	<u>Experiment 1</u> Group 1. Rhyming, sound matching, blending, counting phonemes (segmentation), letter sound Group 2. No intervention	<u>Experiment 1</u> 20-25 minute sessions 20 sessions Total 8 hours
	<u>Experiment 2</u> N = 70 Kindergarten (average learners)	<u>Experiment 2</u> Criterion-based test of computer-taught skills (Undersea Challenge) Segmentation Blending STOPA		<u>Experiment 2</u> 20-minute sessions 16 sessions Total 5 hours
Results: Experiment 1: Group 1 made significantly higher gains on both measures of PA. Experiment 2: Group 1 made significantly higher gains on three of four measures. No statistical gain on Undersea Challenge.				
Hurford (1990)	N = 48 Grades 2 & 3 (average and below average reading)	Segmentation (researcher- constructed)	Group 1. (below average PA & reading) CAI on phonemic discrimination Group 2. (below average PA & reading) No intervention Group 3. (average PA & reading) No intervention	30-45 minute sessions 3-4 sessions Total 90-135 minutes
Results: Group 1 made significantly higher gains in segmentation ability.				

Table 5--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Hurford & Sanders (1990)	N = 32 Grades 2 & 4 (low PA)	Segmentation test	Group 1. CAI training on discrimination of CV pairs Group 2. No intervention	30-45 minute sessions 3-4 sessions
Results: Group 1 had significantly higher gains on segmentation.				
Hurford et al. (1994)	N = 99 Grade 1 (average and below average reading)	Segmentation, WRMT Word Attack WRMT Word Identification	Group 1. CAI training on discrimination of CV pairs followed by teacher-led blending and segmentation Group 2. No intervention Group 3. (average readers) No intervention	15-20 minute sessions 2 sessions per week 20 sessions Total 13 hours
Results: Group 1 (including both children with and without identified reading disabilities) made significantly higher gains on all measures.				

Table 6--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Uhrey & Shepherd, 1993	N = 22 Grade 1 Age 6.5	WRMT Gates-MacGinitie (reading) Roswell-Chall (blending) Rosner (segmentation, deletion) Spellmaster Diagnostic Tests ***Selected subtests from all	Group 1. Spelling instruction (segmentation) CAI spelling games Group 2. CAI reading games with CVC words	20 minute sessions 2 sessions per week 6.5 months Total 17 hours
Results: Group 1 significantly higher on measures of nonword, sight word, and oral reading, spelling, segmentation, and blending.				
Wise & Olson (1992)	N = 28 Ages 7-14 years (reading disabilities)	WRAT--Spelling, WRAT--Reading Nonword	Group 1. Spelling--whole word feedback Group 2. Spelling--segmented feedback	15-40 minute sessions 3-5 days Total .75 to 3 hours
Results: Children in Group 2 who were 10 years of age or older made significantly higher gains than Group 1 on nonword measures. However, when conditions were reversed, and new words practiced, there were no significant differences between groups.				

Table 6--continued.

Study	Subjects	Dependent Measures	Intervention	Duration
Wise & Olson (1995)	N = 103 Grades 2-5 (below average reading)	Phonological awareness IAC Deletion Reading Nonword Decoding Comprehension Spelling Math	Group 1. Reading connected text--whole word feedback. Also teacher instruction (reciprocal teaching approach) Group 2. As above, but with ADD (phonological awareness) PAL (phonological analysis with letters) nonword reading, MARVIN (nonwords), SPELLO (spelling)	Total 25 hours

Results: Group 2 significantly higher on IAC, deletion, nonword, & untimed word reading. Group 1 higher on timed word reading. There were no differences in comprehension or spelling.

phonological awareness (Barker & Torgesen, 1995; Barron et al., 1992; Foster et al., 1994; Hurford, 1990; Hurford & Sanders, 1990; Hurford et al., 1994; Uhry & Shepherd, 1993; Wise & Olson, 1992, 1995) is a relatively new area of research. In three studies, students' auditory discrimination of phonemes (Hurford & Sanders, 1990; Hurford et al., 1994) and segmentation ability (Hurford, 1990) were increased using a training program in which auditory stimuli were computer-presented with increasingly briefer transitions. Barron et al. (1992) continued the research with DECTalk and found that increased phonological awareness skills of nonreaders resulted when words were spoken by a speech synthesizer, and computer-generated print feedback was provided. Wise and Olson (1992) used interactive speech feedback on a talking computer system to improve children's spelling and phonological skills. Wise and Olson (1995) used segmented feedback combined with programs based on the Auditory Discrimination in Depth Program (Lindamood & Lindamood, 1984). The training resulted in increased word and nonword reading skills for the phonological training group. Uhry and Shepherd (1993) found that segmentation and spelling practice using computer games that involved some form of analysis (segmentation) of spoken words facilitated both spelling and reading.

The DaisyQuest (1993) and Daisy's Castle (1993) computer programs, specifically designed to teach both analytic and synthetic phonological skills, were developed and tested by

Foster et al. (1994). Subjects were 27 kindergarten students (ages 5 and 6 years) whose performance on a researcher-constructed test of phonological awareness demonstrated low phonological awareness skills. Children were randomly assigned to a computer-assisted instruction group or a no-intervention control group. After 20 sessions, significant gains for the computer group were noted on measures of phonological awareness.

After making some modifications in the programs, Foster et al. (1994) conducted a second experiment with 70 kindergarten children with average ability in phonological awareness. The students were matched in pairs on verbal ability, and one of each pair was randomly assigned to the computer or control group. At the end of 3 weeks of daily 20-minute sessions, children in the computer group demonstrated significant gains on three out of four tests of phonological awareness. Ceiling effects were noted for the nonsignificant measure.

Effect sizes compared favorably with those obtained from teacher-led programs that had been evaluated in previous research (Wagner et al., 1994). The Wagner et al. (1994) meta-analysis reported an average effect size on phonological awareness measures of 1.23. The five effect sizes obtained in the Foster et al. (1994) studies had an average effect size of 1.05. The Foster et al. design was somewhat weakened by the lack of an attentional control group. Effects of the program on reading skills cannot be determined because no

measures of reading were included in the testing battery. A cross-study comparison of effect sizes was made between teacher-led and computer-assisted instruction. However, the lack of a teacher-taught comparison group in the Foster et al. study prevents conclusions concerning the relative effectiveness of computer-assisted and teacher-led instruction.

In a second evaluation of the DaisyQuest (1993) and Daisy's Castle (1993) programs (Barker & Torgesen, 1995), some of the limitations of the Foster et al. (1994) study were addressed. This study was conducted with below-average first-grade readers (40th percentile or below on the Word Recognition subtest of the WRMT-R and below the 50th percentile on a researcher-constructed test of sound categorization). Children were randomly assigned to the DaisyQuest (1993) and Daisy's Castle (1993) programs, the Hint and Hunt (Beck & Roth, 1984b) word recognition program, or an attentional control group using a math skills program. The 25-minute training sessions occurred four times a week for 4-5 weeks. As in the Foster et al. (1994) study, significant improvements for the DaisyQuest/Daisy's Castle group were obtained on measures of phonological awareness. In addition, the DaisyQuest/Daisy's Castle group significantly outperformed both the Hint and Hunt group and the control group on the Word Recognition subtest of the WRMT-R. No effects of training condition were noted for the nonword reading measures.

Clearly, computer-assisted instruction can be an effective method of increasing the phonological awareness and reading skills of children with and without reading disabilities. Indisputably, such instruction is both time and cost-efficient for both teacher and student. What is missing from the research base is evidence that computer-assisted instruction can provide the same magnitude of effects as teacher-led training. Though the Barker and Torgesen (1995) study was well designed and provided strong support for the effectiveness of the DaisyQuest (1993) and Daisy's Castle (1993) programs, it did not address the question of the relative effectiveness of teacher-led and computer-assisted instruction in phonological awareness. Comparisons across studies can be made (Foster et al., 1994), but these comparisons have limited validity because variables among different studies cannot be held constant. No existing research has provided a direct comparison of the effects of computer-delivered versus teacher-provided phonological awareness intervention.

The Purpose of the Study

The purpose of this study was to compare the effects of computer-assisted instruction, teacher-led instruction, and no instruction on the phonological and reading skills of children with deficits in phonological awareness. By comparing the effects of computer-assisted and teacher-led instruction, conclusions can be drawn about the relative effectiveness of each form of intervention. If children

learn skills equally well or better when instructed by computer, teachers may be justified in providing computer-assisted instruction as a method for increasing phonological awareness.

In choosing software for the computer-assisted treatment group in this study, programs were evaluated according to criteria described in this chapter. The DaisyQuest (1993) and Daisy's Castle (1993) programs were chosen because they provided a close match to those criteria. In Chapter III, the DaisyQuest (1993) and Daisy's Castle (1993) programs are described and evaluated.

Summary of the Review of the Literature

This chapter has provided a summary and analysis of the literature examining the relationship between phonological awareness and reading ability, the development of phonological awareness in good and poor readers, and instructional intervention in phonological awareness. Within this context, the causal connection between phonological awareness and reading, the specific skills that make up the construct of phonological awareness, how instruction can help students acquire these skills, and challenges to implementing such instruction within the general education classroom have been discussed. The research findings on the potential for computer-assisted instruction in phonological awareness, including the implications of previous research for this study, have been summarized. Finally, the purpose of the

present study has been discussed in light of the reviewed research.

CHAPTER III METHODS AND PROCEDURES

Purpose

In this study, three groups were compared. Children in Group A received computer-assisted instruction in phonological awareness skills. Children in Group B received direct instruction in phonological awareness skills led by a graduate student teacher. Children in Group C received no special instruction in phonological awareness skills. The purpose of this study was to compare the effects of computer-assisted instruction, teacher-led instruction, and no instruction in phonological awareness skills on the phonological and reading skills of first-grade students who demonstrated delayed development of phonological awareness. Chapter III describes the methods and procedures used to test six hypotheses regarding the acquisition of phonological and reading skills in young children. Participant selection criteria are discussed, and research settings are described. Dependent measures of instructional effectiveness are examined. Finally, instructional procedures and methods of data analysis are reported.

Research Questions and Hypotheses

Six hypotheses regarding the acquisition of phonological skills in young children were constructed. The following

section includes research questions addressing the acquisition of phonological awareness and the corresponding hypotheses designed to test the effects of group on the phonological and reading skills of participants.

Research Question

Does instruction in phonological awareness skills increase these skills in children with delayed development of phonological awareness?

Hypothesis 1: There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no phonological awareness instruction on measures of phonological awareness skills, including phoneme blending, phoneme segmenting, and phoneme elision.

Research Question

Does instruction in phonological awareness skills increase the reading skills of children with delayed development of phonological awareness?

Hypothesis 2: There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no phonological awareness instruction on standardized measures of nonword reading.

Hypothesis 3: There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no

phonological awareness instruction on a standardized measure of word reading.

Research Question

Is computer-assisted instruction as effective as teacher-led instruction in improving the phonological skills of children who demonstrate delayed development of phonological awareness?

Hypothesis 4: There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on measures of phonological awareness skills, including phoneme blending, phoneme segmentation, and phoneme elision.

Research Question

Is computer-assisted instruction as effective as teacher-led instruction in improving the reading skills of children who demonstrate delayed development of phonological awareness?

Hypothesis 5: There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on standardized measures of nonword reading.

Hypothesis 6: There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on a standardized measure of word reading.

Data from six dependent measures were analyzed to answer the above research questions concerning the effects of Group A (computer-assisted instruction in phonological awareness), Group B (teacher-led instruction in phonological awareness), and Group C (no instruction in phonological awareness) on the phonological and reading skills of participants. Multiple measures were necessary to assess the impact of the interventions across numerous tasks known to demonstrate phonological awareness. These dependent measures are fully described in subsequent sections of this chapter. Because the use of multiple measures increases the probability of Type I error, the alpha level was adjusted from .05 to .0437, using a procedure often employed with orthogonal comparisons (Shavelson, 1988). This adjustment was based on the formula $p(\text{Type I error}) = 1 - (1 - .05) = .0975$. This alpha level was then divided by 2, the number of orthogonal comparisons to be conducted. The resulting alpha level of .0437 applied a more stringent criterion to determine statistical significance. The more rigorous test of significance compensated for the risks inherent in using multiple measures.

Methods and Procedures

Settings and subject selection are described in this section. The instruments and materials used to conduct the research and the instructional procedures employed are examined. Methods of data analysis are described.

Settings and Subjects

In the following sections, research settings are described. The method for selection of study participants is discussed. Descriptive statistics for the socioeconomic status of schools and participants are presented.

Instructional settings. Three schools located in north central Florida were chosen as sites for the study. Two schools served primarily suburban areas. The third school served a predominantly rural population. All three served children in prekindergarten through fifth grade. In School 1, 40% of the students participated in the free and fee-reduced lunch program; in School 2, 38% of the students participated in the free and fee-reduced lunch program; and in School 3, 32% participated in the program. Socioeconomic status of individual students was not considered as a factor in this study. Table 7 provides descriptive statistics for the socioeconomic status of schools and the socioeconomic status of study participants by school.

An important factor in school selection was the availability of adequate computer resources. Because the DaisyQuest (1993) and Daisy's Castle (1993) programs require Apple Macintosh computers, schools with such computers available to first-grade students were chosen. Computer-assisted instruction occurred either in the classroom or the school computer laboratory. Teacher-led instruction took place in a quiet area (a portable building or unused classroom) provided by each school.

Table 7

Description of Socioeconomic Status of Schools and Study Participants

School	Percent of Total Students Receiving Fee-reduced or Free Lunch	Percent of Study Participants Receiving Fee-reduced or Free Lunch
1	40	82
2	38	38
3	32	43

Subject selection. All first-grade students in three elementary schools were given a group-administered, standardized screening test of phonological awareness. The test was administered by the researcher. Students qualified for the study if they scored below the 27th percentile according to the norms provided in the test manual. The 27th percentile was chosen based on previous research with the DaisyQuest (1993) and Daisy's Castle (1993) programs. Foster et al. (1994) showed that computer instruction increased the phonological skills of children whom Barker and Torgesen (1995) described as "normal." The children in the Foster et al. study had a median score of 87% on the Screening Test of Phonological Awareness (Torgesen & Bryant, 1990). Barker and Torgesen (1995) indicated positive effects of computer instruction in phonological awareness for children who scored at or below the 50th percentile on the Sound Categorization

subtest (a test of phonological awareness). In the present study, children who scored at or below the 27th percentile on the Test of Phonological Awareness (TOPA) (Torgesen & Bryant, 1994) were included as participants. The area below the 25th percentile is considered below average (lower quarter of the theoretical normal curve). The TOPA norm table does not include the 25th percentile. The 27th percentile appears in the table as the closest percentile to the 25th. This cutoff point was chosen to allow assessment of effects on children with even greater phonological deficiencies than in the Foster et al. (1994) and Barker and Torgesen (1995) studies.

Students in the English for Speakers of Other Languages (ESOL) program were not included in this study. All other students scoring at or below the 27th percentile were given letters of parental informed consent explaining the purpose of the research as required by the University of Florida Institutional Review Board (see Appendix A). Letters of consent were returned by 73 of these students. Within each research site, participants were randomly assigned to one of the three experimental groups. Four letters of consent were returned after the interventions had begun. These children were allowed to participate in the study, but their data were not included in the statistical analysis. Five children transferred to other schools when their families moved during the study. Data from these children were not complete and, therefore, could not be counted in the analysis. Thus,

complete data were available for 64 children participating in the intervention.

Frequencies were tabulated for demographic variables (age, gender, socioeconomic status, and ethnicity). Demographic information is presented for all participants in Table 8.

Instruments and Materials

In this section, the research instrumentation is described. This section includes information concerning the screening measure used to select the participants in the study. The pretest and posttest measures used to assess the effects of the training are also described.

Screening measure. The Test of Phonological Awareness (TOPA) (Torgesen & Bryant, 1994) is a group-administered screening test designed to assess phonological awareness skills. The TOPA-Early Elementary can be given during first or second grade to identify children whose slow development of phonological awareness may negatively affect their acquisition of reading skills. The early elementary version uses a sound matching format to measure the ability to (a) choose a word whose ending consonant sound is the same as that of a stimulus word and (b) identify the word with a different ending sound from among four words. No reading is required.

The TOPA was chosen as the screening instrument in this study because it has been shown to be reliable and valid both for identifying children at risk for reading failure and for

Table 8

Demographic Data for All Study Participants

	Frequency	Percent
Age		
6	33	51.6
7	30	46.9
8	1	1.6
Total	64	100.0
Gender		
Female	29	45.3
Male	35	54.7
Total	64	100.0
SES		
Free/Reduced	39	60.9
Full Pay	25	39.1
Total	64	100.00
Ethnicity		
Black	25	39.1
White	39	60.9
Total	64	100.0

predicting their response to training in phonological skills. Reliability of the screening instrument is important to establish in an intervention study to ensure stable measurement of the skill to be studied. The internal consistency reliability coefficient reported in the TOPA manual is .97, and the test-retest reliability reported is .77.

Validity is important to establish in an intervention study to ensure that the skill or trait assessed is the same as the skill or trait to be investigated. Four types of validity have been established for the TOPA: (a) content validity, (b) concurrent validity, (c) predictive validity, and (d) construct validity. The four types of validity are discussed in the following paragraphs.

Content validity is the degree to which the content of the test represents the domain of content it is designed to measure (Woodcock, 1987). As stated in the TOPA manual, content validity for the TOPA was established through systematic and controlled item selection and analysis.

Concurrent validity indicates the relative effectiveness of a test, when compared with an independent criterion measure, in assessing a subject's behavior (Woodcock, 1987). Concurrent validity of the TOPA is supported by correlations between the TOPA and other related phonological and reading measures.

Predictive validity was established when the TOPA was administered to children at the beginning of first grade. These children were from two elementary schools serving primarily low socioeconomic status and ethnic minority children. Table 9 presents the concurrent and predictive validity for the TOPA as reported in the TOPA manual.

Construct validity of the TOPA was established with three methods. First, confirmatory factor analysis was performed on tasks to determine whether they measured the

same or different underlying traits (Wagner et al., 1993). A discussion of confirmatory factor analysis as it was applied in the Wagner et al. study appears in Chapter II. The five latent variables were (a) synthesis, (b) analysis, (c) memory, (d) serial naming, and (e) isolated naming. When items on the TOPA were compared to tasks measuring the latent variables, two of the measures in the final measurement model for phonological awareness were very similar to the sound matching items on the TOPA.

Table 9

TOPA Validity Data for Early Elementary Version

	Sound Isolation Task	Segmentation Task	Word Analysis (WRMT-R)	Word Identification (WRMT-R)
Concurrent	.55	.50	.66	.60
Predictive	--	--	.55	--

Note. Data from Test of Phonological Awareness by J. K. Torgesen and B. R. Bryant, 1994, p. 24.

Second, evidence for construct validity was provided by studies in which performance on the TOPA was a significant predictor of variability in the way children responded to subsequent training in phonological awareness (Torgesen & Davis, 1992). The TOPA was the strongest predictor of growth in both analytic (segmentation) and synthetic (blending) skills.

Finally, the construct validity of the TOPA is supported from evidence (Torgesen & Bryant, 1994) that the TOPA provides an accurate measure of the ability to isolate the last phoneme in words. To obtain a correct response, children must have the ability to identify and compare the last sound in words, rather than responding to their global phonological similarity. To show that the TOPA is an accurate measure of the ability to isolate the last phoneme in words, the overall phonological similarity between words in each item of the TOPA was calculated. An index rating of phonological similarity for each item was established. A higher similarity rating indicated the correct answer could be obtained by responding to the global similarities among response choices. For example, in an item requiring the matching of initial phonemes (which word begins with the same sound as rake - ash, rug, or see?), a child might be able to select rug on the basis of its phonological similarity with rake (each contains three phonemes while ash and see contain only two phonemes). Therefore, the child might select rug, the correct response, on the basis of this global phonological similarity, rather than on the basis of the shared initial phoneme /r/. This item would have a relatively high index of phonological similarity. Item difficulty indices were also calculated by obtaining correlations between performance on each TOPA item and the total TOPA score. When item difficulty indices and phonological similarity index values for each of the item

types on the TOPA were compared, none of the correlations were statistically reliable. These low correlations indicated the degree of difficulty of TOPA items was independent of phonological similarity factors. Thus, the TOPA provides an accurate measure of the ability to identify and compare the last sound in words, rather than a measure of responding to their global phonological similarity.

Pre- and posttest measures of phonological awareness.

In Chapter II evidence from confirmatory factor analysis was presented to show that phonological awareness consists of at least two skills, synthesis and analysis (McBride-Chang, 1995; Torgesen et al., 1994; Wagner et al., 1994). Because phonological synthesis and phonological analysis tasks have been validated as measures of phonological awareness, the pretests and posttests in this study included (a) blending, a phonological synthesis task requiring the ability to blend smaller units of speech to form larger units, (b) segmenting, an analysis task requiring the ability to separate larger units of speech into smaller units, and (c) elision, an analysis task requiring deletion of a sound unit. Developed and field tested in Tallahassee, Florida (J. Torgesen, personal communication), these measures were normed on 100 randomly selected children at each grade level, kindergarten through fifth grade. Table 10 provides

Table 10

Normative and Reliability Data for Pretest/Posttest Measures

Dependent Measure	Means	Standard Deviations	Reliability
Phonological Awareness			
Synthesis			
Blending	14.75	6.06	.92
Analysis			
Segmentation	8.75	3.46	.82
Elision	12.30	5.01	.92
Reading			
Nonword			
Word Attack (WRMT-R)	---	---	.95
Nonword Reading Efficiency	10.07	9.18	.98
Real Word			
Word Reading Efficiency	23.47	14.98	.98

Note. Data for Segmentation are for grade 2. None was given for grade 1.

normative and reliability data for the phonological measures. Normative data were provided by Dr. Torgesen (personal communication). Reliability data for the phonological measures are from Torgesen and Barker (1995). Reliability data on the nonword and word efficiency measures were also provided by Dr. Torgesen. The Word Attack reliability figure was taken from the WRMT-R manual (Woodcock, 1987). Appendix

B contains these phonological awareness instruments. In the following sections, the synthesis task (blending) and the two analysis tasks (segmentation and elision) are described.

In the measure of phonological synthesis (blending), two tasks are combined. For each task, the child is asked to say the larger unit by blending together the separate phonemes. For example, to test the ability to blend onset and rime, the examiner says /k/--/at/. The child responds with the word cat. To test the ability to blend phonemes, the examiner says /k/--/a/--/t/, and the child responds with the word cat. Several practice items are given with feedback. The test proceeds until the child makes five consecutive errors. The score is the number of words blended correctly.

In the measure of phonological analysis (segmentation), two tests were used. In the segmentation test, the examiner says a word, and the child is asked to repeat it. Then, the child is asked to pronounce each separate phoneme in the word. For example, the examiner says cat, and the child responds with /k/--/a/--/t/. Practice items are provided with feedback. The test concludes when five consecutive errors are made. The score is the number of words segmented correctly.

In the phoneme elision test, the examiner says a word and asks the child to repeat it. Next, the child is asked to say the word with one linguistic segment deleted. ("Now say cowboy without saying boy." "Now say big without the /b/ sound.") Practice items are administered with feedback, and

the test continues until a ceiling of five consecutive errors is reached. The score is the number of correct items.

The phoneme segmentation and elision tasks are transfer tasks that require children to manipulate individual sounds within words. This skill was not directly practiced on the computer programs or in the small group instruction. In their research using DaisyQuest (1993) and Daisy's Castle (1993) (reviewed in Chapter II), Barker and Torgesen (1995) provided the rationale for testing analysis skills in this manner. If children demonstrate improved performance on these tasks from pretest to posttest, this would provide evidence of some degree of transfer of phonological skills. In the instructional format, the response required is identifying the number of phonemes in the word. In the pretest and posttest format, a child must respond by saying the segmented phonemes (/k/--/a/--/t/) or by saying the word after deleting a phoneme. Thus, successful performance on these tasks represents some ability to transfer phonological knowledge in the upper continuum of difficulty for phonological awareness tasks (Barker & Torgesen, 1995).

Pre- and posttest measures--Reading. The ultimate goal of reading is comprehension, and comprehension is highly dependent on fluent word recognition (Perfetti, 1985). Phonological awareness plays a causal role in this relationship. Table 10 provides normative and reliability data for the reading-dependent measures used in this study.

The nonword reading test is the purest test of decoding because the only way to read the nonwords is to apply phonological decoding skills (Barker & Torgesen, 1995). Pseudowords isolate the application of letter-sound correspondence and blending from word meaning. Poor and good readers tend to differ most saliently on pseudoword recognition tasks because poor readers rely less on the phonological attributes of words than good readers (Vellutino & Scanlon, 1987). For this reason, training in phonological awareness might be expected to affect performance on nonword tests most directly. Therefore, two measures of nonword reading were included in the pre- and posttest battery. Tests of nonword reading included (a) the Word Attack subtest (WRMT-R) and (b) the Nonword Reading Efficiency measure. Though each test measures the same skill, the WRMT-R Word Attack subtest assesses accuracy only and does not yield information about a child's ability to decode fluently. Because fluent decoding is highly correlated with comprehension (Perfetti, 1985), the Nonword Reading Efficiency measure was included in the test battery to provide a measure of fluency. Together, the WRMT-R Word Attack subtest and the Nonword Reading Efficiency measure provided a complete picture of the ability to apply phonological decoding skills fluently and accurately.

The Word Attack subtest (WRMT-R) assesses skill in using phonic and structural analysis to read nonsense words. It is an untimed test in which children pronounce a series of

increasingly difficult nonsense words until they reach a ceiling of six consecutive errors. The score is the number of words read accurately.

Content validity was established through controlled selection of items. Items in the Word Attack subtest cover a range of difficulty based on the performance of average students from a nationwide norming population. Item difficulty ranges from 96% to 50% average mastery at each grade level (Woodcock, 1987).

Concurrent validity is supported by correlations between the WRMT-R and the Woodcock-Johnson Achievement Tests-Revised (WJ-R) (Woodcock & Johnson, 1989, 1990). Relatively high correlations at grade 1 for the WRMT-R Word Attack subtest and the WJ-R subtest, cluster, and total scores have been reported (Woodcock, 1987). Table 11 presents the correlation coefficients for these measures.

Table 11

Validity Data for the Word Attack Subtest-Correlations with Word Reading Subtests of the Woodcock-Johnson Achievement Tests-Revised

Word reading subtests (WJ-R)	Word Attack Subtest (WRMT-R)
Word Identification and Recognition	.75
Word Attack	.64
Basic Skills Cluster	.69

Note. Data from the WRMT-R manual by R. W. Woodcock, 1987, p. 100.

The Nonword Reading Efficiency measure (see Appendix C) was developed by Drs. Joseph Torgesen (personal communication) and Richard Wagner of the Psychology Department at Florida State University. In this nonword measure, both fluency and accuracy are assessed. Children are given 45 seconds to read a list of nonwords. The score is the number of nonwords read accurately in the time allowed. The Nonword Reading Efficiency Measure was field tested in Leon County, Florida, on randomly selected students from six elementary schools.

The word reading measure is an assessment of the effects of phonological awareness training on children's ability to read real words. Because the expected result of reading is comprehension, and comprehension is dependent on fluent word recognition (Perfetti, 1985), assessing the effects of phonological instruction on children's ability to read words is important. The pretest and posttest battery included a measure of word reading to assess the effects of phonological training on the word recognition of students. The Word Reading Efficiency measure (see Appendix D) is highly correlated with corresponding measures of word reading from the WRMT-R (.90). However, the number of items at the lower levels of the WRMT-R is limited. Few items at the first-grade level make the test less sensitive to gains in reading ability. The greater number of items included at this level in the Word Reading Efficiency measure was expected to

provide a more sensitive measure of ability (J. Torgesen, personal communication).

The Word Reading Efficiency measure was developed and field-tested by Drs. Torgesen and Wagner (personal communication). The Word Reading Efficiency measure was field tested in Leon County, Florida, on randomly selected students from six elementary schools. This test assesses fluency and accuracy with both phonetic and sight word reading skills, providing a measure of context-free word level reading. The score is the number of words read correctly in 45 seconds.

Because word reading is highly correlated with comprehension (Perfetti, 1985), no measures of passage comprehension were included. There is evidence that nonword reading is also positively related to comprehension. Relatively high correlations at grade 1 are reported among the Word Attack, Passage Comprehension, and Total Comprehension measures of the WRMT-R (Woodcock, 1987). Positive correlations are also reported at grade 1 for the WRMT-R Word Attack subtest and the Passage Comprehension, Total Reading, and cluster scores of the WJ-R (Woodcock & Johnson, 1989, 1990). Table 12 provides the correlation coefficients at grade 1 for the measure of nonword reading (Word Attack subtest) used in this study.

Instructional Procedures

In the following sections, procedures for planning and delivering instruction are described. The training of

Table 12

Correlations Between the WRMT-R Word Attack Subtest and Comprehension Measures of the Woodcock-Johnson Achievement Tests-Revised at Grade 1

Comprehension Subtests	Word Attack (WRMT-R)
Reading Comprehension	.43
Reading Comprehension Cluster	.78
Total Reading-Full Cluster	.87

Note. Data from the WRMT-R manual by R. W. Woodcock, 1987, p. 100.

graduate students who served as supervisors of the computer-assisted instruction and as teachers of the direct instruction groups is discussed. A description of the computer-assisted and direct instruction interventions is provided.

Personnel training. Graduate students in special education were trained to supervise the children in the computer-taught group and to provide instruction in the teacher-led group. Depending on the number of hours each graduate student was able to commit to the study, some supervised students in the computer-assisted group and also provided instruction in a teacher-led group. Others were responsible for only one of the interventions.

Training in the computer-assisted intervention was conducted by the researcher. Though the graduate students

may have had some knowledge about phonological awareness and familiarity with interventions for its training, a review of the concept of phonological awareness and its relationship to reading was provided. Phonological skills were defined and demonstrated, and the interventions used in this study were explained. The researcher taught these students to operate the two computer programs, Daisy Quest (1993) and Daisy's Castle (1993), and to navigate through the different areas of each program. Trainees practiced in the tutorial and mastery demonstration formats. At the conclusion of the session, trainees learned how to print out a certificate similar to those they would be printing for the children they supervised.

Training for the graduate students in the teacher-led instructional procedures was conducted by the researcher. These students also received a review of the concept of phonological awareness and its relationship to reading. Phonological skills were defined and demonstrated, and the interventions to be used in this study were explained. A summary of the principles of direct instruction was also presented. (These principles were described in Chapter II.) Scripts following a direct instruction format (Appendix E), representative pictures (Appendix F), and practice in the form of games (Appendix G) were provided for each of the 20 direct instruction lessons. The instructor modeled the procedures of one lesson. The trainees practiced in groups to become comfortable with reading the scripts, pointing to

representative pictures, and signaling responses. The researcher observed each student and provided corrective feedback on all procedures as needed.

Description of intervention--Computer-assisted group.

Apple Macintosh computers were used to provide the computer intervention. Each learning station included a computer unit, a color monitor, and a mouse. In addition, children listened to the computer using standard earphones connected through an external jack.

The DaisyQuest (1993) and Daisy's Castle (1993) computer software programs were used for computer-assisted instruction. These programs teach rhyming, blending, and segmentation, the phonological skills that have been shown in construct validation studies (McBride-Chang, 1988; Torgesen et al., 1994; Wagner et al., 1993; Yopp, 1988) to be valid measures of phonological awareness. Training in these skills has consistently resulted in positive effects on children's phonological and reading skills (for example, Davidson & Jenkins, 1994; Fox & Routh, 1984; O'Connor et al., 1996; Torgesen et al., 1992; Treiman & Baron, 1983). DaisyQuest and Daisy's Castle are auditory programs that contain seven instructional strands based on the following skills:

1. Recognizing words that rhyme
2. Recognizing words that have the same beginning sound
3. Recognizing words that have the same ending sound
4. Recognizing words that have the same medial sound
5. Recognizing words presented in the onset-rime format

6. Recognizing words presented as individual phonemes
7. Counting the number of phonemes in words.

The first four strands teach students about words that rhyme and words with the same beginning, middle, and ending sounds. These strands make up the DaisyQuest (1993) program. The Daisy's Castle (1993) program contains the fifth and sixth strands, where students learn and practice two-part blending and whole word blending, and the last strand, where students must segment sounds in words. Thus, the two programs together provide training in both analytic and synthetic phonological skills with the majority of instruction occurring in the phoneme identification format.

Linking the learning tasks is the DaisyQuest (1993) story theme involving a search for Daisy, a friendly dragon whose hiding place can be discovered by gaining clues from completing instructional activities. In Daisy's Castle (1993) the theme involves searching for Daisy's lost eggs. This motivational theme is integrated into a series of interactive tasks using a game format with engaging graphics and digitized speech.

The first computer session established rapport between the university teacher and the group participants. In this session, teachers set behavioral expectations and introduced the children to the computer program. Children were introduced to Daisy and allowed to choose one of the characters from Daisy's fantasy world to represent themselves as they began their search for her. They learned how to

choose among the sequences of instructional activities offered for the various skill strands. Other conventions of the program were explained, and children were allowed to practice going to and from the different fantasy settings provided for instruction.

In subsequent sessions, children worked through the various skill strands previously described. Within the programs, each skill strand is introduced in a tutorial section where children listen to instruction and are presented with both examples and nonexamples. Children practice the skill by hearing words spoken via computer and use the mouse to respond in a yes/no format. Corrective feedback is provided by the computer for each response. For example, the screen shows a picture of a bat and a hat and pronounces the words. The child is asked, "Do these words rhyme?" Responses are made by clicking on a picture of a chipmunk shaking its head "yes" or "no." The computer responds with positive comment ("Good work!") for correct responses or a correction ("That's not right. Bat and sock do not rhyme because they do not end in the same sound.") Additional practice in a multiple-choice format follows. For example, the screen shows pictures of a pail, a buck, and a bud and pronounces each word. A fourth picture (mud) appears below. The child is asked, "Which one rhymes with mud?" Responses in the multiple-choice format are made by clicking on the picture whose name rhymes with the target word (mud in this example). Corrective feedback is similar to that

previously described. Placing the cursor on a picture without clicking causes its name to be repeated. Thus, a child can hear the word corresponding to each picture as often as needed.

After the tutorial section of each skill, the mastery section provides the opportunity to demonstrate proficiency by correctly answering five consecutive questions in the yes/no format and five in the multiple-choice format. No feedback is provided in the mastery mode. If mastery is not attained, the child has the option of practicing in the tutorial mode before attempting the mastery section again or choosing the mastery mode again with no additional instruction. Stimulus words and pictures are rotated at random and are rarely repeated in the same session. Once a child demonstrates mastery in both the yes/no format and the multiple-choice format, she or he has earned a clue and a treasure. In Daisy Quest (1993), mastery of the four skill strands (rhyming, beginning sounds, ending sounds, and medial sounds) earns enough clues to find Daisy in her hiding place. At this point, a certificate of achievement can be printed. In Daisy's Castle (1993), mastery of the three skill strands (blending in the onset-rime format, blending individual phonemes, and counting the number of phonemes in words) earns enough clues to locate Daisy's lost eggs. Again, a certificate of achievement can be printed.

For both the tutorial and mastery sections, different levels (based on speed of response) provide challenging

practice and build fluency. At level one, response time is unlimited. Level two allows 8 seconds to respond, while level three limits response time to 4 seconds. At each new session, the child begins at the same skill level as in the previous session. Within these constraints, children have a range of choice about the sequence of instructional activities that is followed.

In the present study, time spent on each skill strand in the computer-instructed group was based solely on the individual child's rate of skill acquisition. In DaisyQuest (1993), children were allowed to choose the skill they would practice. Once a child had mastered the four skills in DaisyQuest, she or he progressed to Daisy's Castle (1993). In Daisy's Castle, a child had the option of working on any of three skills. Again, progress through the program was determined by the individual's rate of skill acquisition based on demonstration of mastery with set criteria. After a child had mastered all of the skills in each program, the response time was automatically adjusted by the computer to allow less time for responding.

Each child in the computer-assisted group worked at her or his own computer. At two schools, children in the computer-assisted group were scheduled to use computers in their classrooms for 30-minute sessions. At the third school, children in the computer-assisted group were taken to a computer lab where they worked at individual stations for 30 minutes. At all schools, children were supervised during

their computer sessions by graduate students whose training was described previously.

During their supervision of the computer-instructed group, university graduate students provided redirection to task and behavior management when needed. They escorted participants to and from their classrooms when appropriate. Supervisors provided no instruction related to reading or phonological skills.

Description of intervention--Teacher-led instruction.

Sessions were planned to cover the same skill strands as the DaisyQuest (1993) and Daisy's Castle (1993) programs. The curriculum was developed by two university graduate students as part of their master's research and followed direct instruction principles as discussed in Chapter II. There were three components to the curriculum. First, a prepared script provided the narrative for instructing children in the skill. Second, illustrations provided examples and nonexamples of each skill. Third, a game such as Bingo or Memory provided practice in each skill. The lessons were planned to be highly interactive with children responding in unison on signal.

Scripts ensured consistency across the several instructional groups that constituted the teacher-led treatment group. Depending on the skill strand instructed, the teacher showed pictures of various activities or objects, pronounced the words the pictures represented, and asked a yes/no or multiple-choice response question. For example, in

the rhyme strand, the teacher might say, "bat, cat (while displaying representative pictures)-- do these words rhyme?" Children responded chorally or individually, as directed, and were given immediate corrective feedback.

The following is an example of part of a rhyming lesson. The teacher narration appears in italics. Complete scripts for all lessons appear in Appendix E. Representative illustrations appear in Appendix F. A representative game appears in Appendix G.

Teacher: *Today we are going to learn about rhyming. I think you are going to like the activity because we will play games. Rhyming is when words end in the same sound. Here is a rhyme: bat (Teacher holds up picture book and points to picture of a hat), bat (points to picture of a bat). They both end with the same sound. Some words do not rhyme. Sock (Teacher points to picture of a sock), bat (points to picture of a bat). Sock ends in ock, bat ends in at. Remember, words only rhyme if they end in the same sound. Now it's your turn. I will show you two pictures, and you will tell me if the words rhyme. Let's do the first one together. Everyone needs to answer on signal. This is how I signal (teacher taps table). Remember, only I signal. (Teacher holds up picture of wing and dive. Teacher points to picture of a wing). This is wing. What is this? (signal).*

Students: "Wing."

(Repeat procedure until all students are correctly answering on signal,)

(Teacher points to dive) This is dive. What is this?

(signal)

Students: "Dive"

Teacher: Do the words wing and dive rhyme? (signal)

Students: "No"

Teacher: Correct. Wing and dive do not rhyme because they do not end in the same sound. (Point to picture of a wing.) Wing ends in ing. (Point to dive.) Dive ends in ive.

Progression from one skill strand to the next skill strand occurred only when every child in the group demonstrated mastery of the current skill. Thus, time spent on each skill depended on the rate at which the group as a whole was able to acquire skills. Mastery was determined by teacher judgment based on children's choral and individual responding. By requiring choral responding, teachers could identify any child having difficulty. For example, a child not responding on signal, or whose responses lagged behind those of the group, could be identified and provided more opportunities for individual responding. Unlike the computer instruction, teachers could also ask for other types of responses from the children such as "Tell me a word that rhymes with cat" or "What sound is at the end of pig?" Using these responses, teachers could vary their instructional

format, an advantage that the computerized instruction lacked.

At an introductory session, the university teacher established rapport with the children. During this session, behavior expectations and reinforcements were discussed. Reinforcement in the form of stickers was planned to provide extrinsic rewards corresponding to the "clues" and "prizes" the computer provided for children in the computer-assisted group. A practice lesson familiarized children with the direct instruction format to be used. Children practiced choral responding when a hand signal was given. At the end of the session, children played a short rhyming game. Sticker sheets were distributed, and children were told how stickers could be earned for appropriate participation in the group (attending to the stimulus pictures and their names and responding on cue).

Fidelity of treatment for the teacher-led groups was established by reliability checks conducted by the researcher, who attended three randomly selected group instruction sessions at each research site to insure that university teachers consistently adhered to scripts and other procedures. These reliability observations are discussed in detail in Chapter IV.

Description of Condition C--Control group. Those participants assigned to the control group received no special instruction in phonological awareness, nor did they receive extra instruction of any kind beyond the reading

instruction provided within their classrooms. Pretest and posttest data were collected on these participants for comparison with the two intervention groups. After posttesting was completed, the children in the control group were given the opportunity to work through the DaisyQuest and Daisy's Castle programs.

Design and Data Analysis

In this section the design of the study is discussed, including implementation of the study and methods of data analysis. The implementation of the study took place in three phases: (a) Phase 1 consisted of screening, obtaining parental permission, training personnel, and pretesting; (b) Phase 2 consisted of 24 sessions of phonological awareness instruction; and (c) Phase 3 consisted of posttesting and data analysis.

Experimental design. An experimental pretest-posttest control-group design was employed in this study. This design allowed the assessment of changes in the dependent variables over time. The inclusion of a no-treatment control group ensured that changes in the dependent variables from pretest to posttest were not due to factors other than the independent variable (method of instruction). Random assignment of participants to the three experimental groups controlled for threats to internal validity.

Implementation. During Phase 1 of the study, the Test of Phonological Awareness (Torgesen & Bryant, 1994) was administered to all first-grade students in each of three

selected elementary schools. Study participants were selected and pretested, and personnel training was conducted as previously described.

During Phase 2, participants in Group A received instruction via computer at individual stations in their classroom or in a computer laboratory. Participants in Group B received instruction in teacher-led groups consisting of 4-6 students each. Participants in Group C received no instruction beyond their regular classroom activities. Children in two schools were scheduled to receive 30 minutes of instruction 4 days per week over a period of 6 weeks, a total of 24 sessions. Children in the third school received 30 minutes of instruction 5 days per week for 5 weeks, a total of 24 sessions (a make-up day for absences was held the last Friday of the final week in this school). Among the three research sites, 21 students received computer-assisted instruction; 21 received direct instruction; and 22 received no extra instruction.

The duration of the study was based on previous research findings. In a study using the same computer programs (Barker & Torgesen, 1995), children received approximately 8 hours of training. The average effect size reported ranged from 1.1 standard deviation units (SDU) for a computerized test of phonological awareness skills taught in the computer program to .35 SDU for the measure of blending. A meta-analysis (Wagner, 1988) evaluated the effects of thirteen teacher-led phonological awareness training programs

on subsequent phonological skills. Barker and Torgesen (1995) reported that the average effect size in these studies was 1.23 SDU. The average length of training reported in the meta-analysis was 9 hours. The present study provided a total of 12 hours of phonological awareness instruction to each treatment group. Because favorable effect sizes have resulted from interventions with a duration of 8 to 9 hours, the 12 hour intervention in this study was expected to yield positive results.

In Phase 3, participants were readministered all of the pretests as posttests. Pre- and posttest data were statistically analyzed in order to compare the effects of the two methods of phonological awareness instruction and no instruction on the phonological skills and reading ability of study participants.

Data analysis. The purpose of the study was to compare computer-assisted instruction with teacher-led instruction and no instruction in phonological awareness skills for first-grade children with below average phonological awareness. To evaluate the effects of computer-delivered, teacher-led, and no instruction in phonological awareness, six hypotheses were constructed. In Phase 3 of the study, all pretests except the screening test (TOPA) were readministered to participants.

Planned orthogonal comparisons were conducted to determine whether significant differences were present among the three groups. Planned comparisons are appropriate when

hypotheses underlying these comparisons have been planned before the study was conducted, and strong theoretical and empirical bases existed for specifying these hypotheses (Shavelson, 1988). Each comparison must be independent of every other comparison in that it must provide nonoverlapping information with other comparisons. Under these conditions, the t -test is used to examine the hypotheses statistically. In this study two independent orthogonal comparisons were planned for each dependent variable. Table 13 presents the design for testing the null hypotheses using planned orthogonal comparisons. The results of the statistical analyses are discussed in Chapter IV.

Summary

In this study, three groups were compared. Children in Group A received computer-assisted instruction in phonological awareness skills. Children in Group B received direct instruction in phonological awareness skills led by graduate student teachers. Children in Group C received no special instruction in phonological awareness skills. The purpose of the study was to compare the effects of computer-assisted instruction, teacher-led instruction, and no instruction in phonological awareness skills with first-grade students who demonstrated delayed development of phonological awareness. Six hypotheses regarding the acquisition of phonological skills in young children were

Table 13

Design for Testing the Null Hypotheses Using Planned Orthogonal Contrasts

Dependent Measures		Contrast 1			
		<u>Experimental Groups A&B</u>		<u>Comparison Group C</u>	
		Pretest	Posttest	Pretest	Posttest
1-Blending	H1: There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no phonological awareness instruction on measures of phonological awareness skills, including phoneme blending, phoneme segmenting, and phoneme elision.				
2-Segmentation					
3-Elision					
4-WRMT-R Word Attack	H2: There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no phonological awareness instruction on standardized measures of nonword reading.				
5-Nonword Efficiency Reading					
6-Real Word Reading	H3: There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no phonological awareness instruction on a standardized measure of word reading.				
Dependent Measures		Contrast 2			
		<u>Experimental Group A</u>		<u>Experimental Group B</u>	
		Pretest	Posttest	Pretest	Posttest
1-Blending	H4: There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on measures of phonological awareness skills, including phoneme blending, phoneme segmenting, and phoneme elision.				
2-Segmentation					
3-Elision					
4-WRMT-R Word Attack	H5: There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on standardized measures of nonword reading.				
5-Nonword Efficiency Reading					
6-Real Word Reading	H6: There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on a standardized measure of word reading.				

tested. Dependent measures of instructional effectiveness were statistically examined to compare the effects of group on the phonological awareness and reading skills of first-grade students.

CHAPTER IV RESULTS

Introduction

The purpose of this study was to compare the effects of computer-assisted, teacher-led, and no instruction in phonological awareness on the phonological and reading skills of children with deficits in phonological awareness. By comparing different methods of instruction, conclusions could be drawn about the relative effectiveness of each form of intervention. If children learn skills equally well or better when instructed by computer, teachers may be justified in providing computer-assisted instruction as a method for increasing phonological awareness. The following questions guided the research:

1. Does instruction in phonological awareness skills increase these skills in children with delayed development of phonological awareness?
2. Does instruction in phonological awareness skills increase the reading skills of children with delayed development of phonological awareness?
3. Is computer-assisted instruction as effective as teacher-led instruction in improving the phonological and reading skills of children who demonstrate delayed development of phonological awareness?

To answer these questions, three groups were compared. Children in Group A received computer-assisted instruction in phonological awareness skills. Children in Group B received direct instruction in phonological awareness skills led by graduate student teachers. Children in Group C received no special instruction in phonological awareness skills. Dependent measures of instructional effectiveness were statistically examined to compare the effects of group on the phonological awareness and reading skills of first-grade students.

This chapter reports the results of the statistical analyses of the data from this study. Methods employed to ensure the reliability of instructional and measurement procedures are described. Demographic data are presented to demonstrate the initial equivalency of intervention groups. The statistical models used to analyze the data are explained, and the results of the data analyses are examined.

Reliability of Instructional and Measurement Procedures

Procedures were implemented to ensure reliability of instruction and measurement throughout the duration of the study. Graduate students from the university's Department of Special Education were employed to supervise the children assigned to the computer-assisted intervention group (Group A) and to serve as instructors in the teacher-led intervention group (Group B). Because the research was conducted in three schools, it was necessary to ensure that

instructional content and reliability of procedures within each group were consistent across the research sites. Procedures were also implemented to ensure scoring consistency for the initial screening test as well as the pre- and posttests across all participants.

Procedural Reliability

Several methods were used to ensure fidelity of treatment for Group A and Group B among the three schools. For Group A, the content of the intervention was controlled by the program itself. Formal reliability observations of lessons (averaging five per school) were conducted by the researcher. Observations of the computer-assisted instruction were made to ensure that children began and ended their computer sessions on time, that they received help in the event of computer malfunction, and that they were attentive to task. Observations also ensured that in the computer-assisted instruction group no teacher instruction was offered. Thus, all instruction for Group A in phonological skills was provided by computer.

For Group B, the content of the intervention was controlled by the use of scripted lessons as described in Chapter II (see Appendix E). Formal observations of Group B lessons (averaging five per school) were also conducted by the researcher using a checklist containing 10 observable behaviors relating to the consistent implementation of the direct instruction curriculum (see Appendix H). To compute a percentage that would represent the fidelity of treatment for

each school, a variation of the formula suggested by Tawney and Gast (1984) was employed:

$$\frac{\text{Observed behaviors}}{\text{Observed behaviors} + \text{Unobserved behaviors}} \times 100 = \text{Reliability Percentage}$$

For School 1, the reliability percentage was 93%, for School 2, the reliability was 98%, and for School 3, reliability was 100%.

Reliability of Measurement

The screening test was administered and scored by the researcher. Scoring reliability for the screening test was established by employing an independent scorer who randomly selected 20% of the tests for rescoring. The ratio of agreements to disagreements was calculated based on the Tawney and Gast (1984) formula:

$$\frac{\text{Agreements}}{\text{Agreements} + \text{Disagreements}} \times 100 = \text{Percent of Agreement}$$

The interscorer reliability for the screening test was 96%.

All pre- and posttests were administered by graduate students who were blind to the treatment condition of each participant. Graduate students were trained by the researcher. Forty percent of the testing sessions at each school were observed by the researcher, and the percentage of agreements versus disagreements was calculated as for the

screening test. The interscorer reliability coefficient was 81%.

Statistical Analysis of the Data

Statistical analyses were conducted to ensure the initial equivalency of groups and to compare the effects of the interventions on the phonological and reading skills of the children in this study. This section presents data on the ages, gender, race, and socioeconomic status of study participants. In addition, results of the statistical analyses of dependent measures of instructional effectiveness are examined to compare the effects of group on the phonological awareness and reading skills of first-grade students.

Equivalency of Intervention Groups

Several analyses were completed to determine if there were any preexisting differences between the experimental and control groups. Table 14 presents the results of the analysis of variance (ANOVA) used to compare the three groups by age. Results revealed no significant differences between groups with respect to age.

Table 15 provides a summary of the distribution of subjects into groups by gender. For gender, the chi-square (χ^2) analysis revealed no differences between groups ($\chi^2 = 4.499$, 2, $p = .105$). Table 16 presents a summary of the distribution of subjects into groups by race. For race, the χ^2 also revealed no differences ($\chi^2 = 5.358$, 2, $p = .069$).

Table 14

Summary of Analysis of Variance for Age

Source of variation	df	Sum of Squares	F	p
Group (computer, teacher control)	2	.2357	1.0142	.3687

Table 15

Distribution of Subjects by Gender

Group	Female	Male
Computer	11	10
Teacher	12	9
Control	6	16

Table 16

Distribution of Subjects by Race

Group	Black	White
Computer	12	9
Teacher	8	13
Control	5	17

An additional analysis of the comparability of groups used participation in the federally subsidized school-lunch program to categorize subjects by socioeconomic status (SES). The three categories were free (fully subsidized), reduced (partially subsidized), and paid (not subsidized). Table 17 presents the number of children in each SES category by group. The chi-square tests used to compare groups by SES indicated no significant differences across groups ($\chi^2 = 7.472$, 4, $p = .113$).

Table 17

Distribution of Subjects by Socioeconomic Status

Group	Free	Reduced	Paid
Computer	11	5	5
Teacher	12	2	7
Control	7	2	13

Finally, the means of pretest scores on the three phonological awareness dependent measures (blending, segmentation, and elision) and the three reading dependent measures (nonword reading, nonword efficiency reading, and real word reading) for all groups were calculated. The data were compared across the three groups using the ANOVA approach. Table 18 presents the means, standard deviations, and statistical significance for the six pretests

Table 18

Comparison of Pretest Means by Group

Dependent Measure	Computer Group (n = 21)		Teacher Group (n = 21)		Control Group (n = 22)		Z	df	p
	Mean (Standard Deviation)		Mean (Standard Deviation)		Mean (Standard Deviation)				
Blending	15.33 (5.93)		16.24 (5.04)		18.05 (5.05)		1.438	2	.245
Segmentation	7.05 (4.77)		7.10 (3.52)		8.36 (4.39)		.664	2	.518
Elision	10.14 (3.09)		8.86 (4.93)		11.32 (5.66)		1.471	2	.238
Woodcock Nonword	8.19 (5.28)		7.71 (6.11)		7.68 (6.25)		.049	2	.952
Nonword Efficiency	6.24 (3.63)		7.10 (5.51)		8.14 (5.88)		.742	2	.480
Real Word	14.14 (7.55)		14.76 (11.25)		14.95 (7.73)		.047	2	.954

administered. Examination of these data revealed no statistical differences among the three groups on the pretest measures.

Descriptive Summary of Pretest to Posttest Data

Table 19 presents statistics describing the central tendency and variability of the data collected in this study by group.

Inferential Analysis of the Data

Several statistical analyses of dependent measures of instructional effectiveness were examined to compare the effects of instruction and no instruction on the phonological awareness and reading skills of first-grade students. The first analysis was used to determine if, within each group, children made significant gains on dependent measures from pretest to posttest. In this analysis, *t*-tests compared pretest to posttest differences on each measure. Then, the Analysis of Covariance (ANCOVA) was employed to determine the effects of group on participant's phonological and reading skills. Finally, two planned orthogonal contrasts were conducted. The first contrast examined the differences between children receiving instruction in phonological awareness and those receiving no instruction in phonological awareness. The second contrast examined the differences between children receiving computer-assisted instruction and those receiving teacher-led instruction.

Table 19

Comparison of Prefest and Posttest Means by Group

Dependent Measure	Computer Group		Teacher Group		Control Group	
	Prefest (Standard Deviation)	Posttest (Standard Deviation)	Prefest (Standard Deviation)	Posttest (Standard Deviation)	Prefest (Standard Deviation)	Posttest (Standard Deviation)
Blending	15.33 (5.93)	18.90 (4.66)	16.24 (5.04)	18.24 (4.79)	18.05 (5.05)	20.32 (5.19)
Segmentation	7.05 (4.77)	10.76 (3.11)	7.10 (3.52)	12.14 (2.89)	8.36 (4.39)	10.45 (3.62)
Elision	10.14 (3.09)	11.76 (3.16)	8.86 (4.93)	11.71 (5.30)	11.32 (5.66)	13.18 (4.87)
Woodcock Nonword	8.19 (5.28)	9.05 (5.76)	7.71 (6.11)	10.62 (6.23)	7.68 (6.25)	11.68 (7.10)
Nonword Efficiency	6.24 (3.63)	8.43 (4.78)	7.10 (5.51)	9.29 (6.87)	8.14 (5.88)	10.50 (6.18)
Real Word	14.14 (7.55)	18.76 (9.56)	14.76 (11.25)	19.57 (12.29)	14.95 (7.73)	22.73 (11.62)

Results of t-tests. Tables 20-22 present the results of the paired t-tests for each measure that examined pre- to posttest gains by group. Results of the t-tests indicated that all groups made significant progress on all measures except the computer-assisted group on the Woodcock Nonword Reading measure. Thus, significant within-group pre- to posttest differences were apparent.

Results of the ANCOVA. The analysis of covariance (ANCOVA) approach was chosen as a method to examine between-group differences because preliminary analyses indicated no differences in performance on the pretests across the intervention groups. Because no statistical differences were found, the pretest scores were appropriate to use as covariates in the ANCOVA. The most critical assumption of the ANCOVA is homogeneity of regression (Shavelson, 1988). Tests of homogeneity of regression were conducted for each dependent measure to determine whether this assumption was met. For the three phonological variables, results indicated that the assumption was valid ($p > .05$). For the three reading dependent measures, the assumption was met for the two nonword measures ($p > .05$), but a violation of the assumption was found for the real word measure [$F(5.58) = 77.694, p < .05$]]. Therefore, the ANCOVA approach was appropriate for the phonological awareness measures (blending, segmentation, elision, and total phonological

Table 20

Mean Gains on Dependent Measures--Computer Group

Dependent Measure	Mean Gain	Standard Deviation	df	t	p
Blending	3.57	4.07	20	4.022	.001*
Elision	1.62	2.62	20	2.835	.010*
Segmentation	3.71	3.86	20	4.407	.000*
PA Total	8.90	7.15	20	5.703	.000*
Woodcock Nonword	.86	4.08	20	.963	.347
Nonword Efficiency	2.19	2.89	20	3.471	.002*
Real Word	4.62	3.71	20	5.709	.000*
Total Reading	7.67	6.13	20	5.735	.000*

*Significant at the $p < .0437$ level.

Table 21

Mean Gains on Dependent Measures--Teacher Group

Dependent Measure	Mean Gain	Standard Deviation	df	t	p
Blending	2.00	3.33	20	2.751	.012*
Elision	2.86	3.40	20	3.856	.001*
Segmentation	5.05	3.25	20	7.122	.000*
PA Total	9.90	6.67	20	6.805	.000*
Woodcock Nonword	2.90	4.49	20	2.962	.008*
Nonword Efficiency	2.19	3.87	20	2.595	.017*
Real Word	4.81	3.93	20	5.605	.000*
Total Reading	9.90	9.24	20	4.915	.000*

*Significant at the $p < .0437$ level.

Table 22

Mean Gains on Dependent Measures--Control Group

Dependent Measure	Mean Gain	Standard Deviation	df	t	p
Blending	2.27	3.63	20	2.939	.008*
Elision	1.86	3.28	20	2.661	.015*
Segmentation	2.09	2.89	20	3.389	.003*
PA Total	6.23	6.02	20	4.849	.000*
Woodcock Nonword	4.00	4.74	20	3.957	.001*
Nonword Efficiency	2.36	4.04	20	2.743	.012*
Real Word	7.77	5.57	20	6.544	.000*
Total Reading	14.14	8.90	20	7.452	.000*

*Significant at the $p < .0437$ level.

awareness) and three reading measures (Woodcock nonword, nonword efficiency, and nonword total. An interaction model was needed for the real word measure.

Table 23 presents results of the ANCOVA for the measure of segmentation. This analysis indicated significant effects of group for the phonological measure of segmentation ($F = 4.41$, 2, $p = < .0437$). The independent variable for this analysis was group (computer, teacher, or control). The covariate was the pretest.

Table 23

Summary of Analysis of Covariance for Segmentation Task

Source of Variation	df	Sum of Squares	F	p
Segmentation pretest	1	252.90	39.63	.000*
Group (computer, teacher, control)	2	56.27	4.41	.016*
Error	60	382.94		

*Significant at the $p < .0437$ level.

Tables 24 through 29 summarize the results of the ANCOVA for the dependent measures of blending, elision, total phonological awareness, Woodcock nonword, nonword efficiency, and nonword total. The independent variable for each of these analyses was group (computer, teacher, or control). The covariate was the corresponding pretest. The analyses of

Table 24

Summary of Analysis of Covariance for Blending Task

Source of Variation	df	Sum of Squares	F	p
Blending pretest	1	807.45	74.43	.000*
Group (computer, teacher control)	2	17.88	.82	.444
Error	60	650.94		

*Significant at the $p < .0437$ level.

Table 25

Summary of Analysis of Covariance for Elision Task

Source of Variation	df	Sum of Squares	F	p
Elision pretest	1	752.07	88.95	.000*
Group (computer, teacher control)	2	8.77	.52	.598
Error	60	507.30		

*Significant at the $p < .0437$ level.

Table 26

Summary of Analysis of Covariance for Total Phonological Awareness

Source of Variation	df	Sum of Squares	F	p
PA Total pretest	1	4927.39	127.51	.000*
Group (computer, teacher control)	2	65.96	.85	.431
Error	60	2318.52		

*Significant at the $p < .0437$ level.

Table 27

Summary of Analysis of Covariance for Nonword Efficiency

Source of Variation	df	Sum of Squares	F	p
Nonword Efficiency pretest	1	1399.93	104.60	.000*
Group (computer, teacher control)	2	1.04	.04	.962
Error	60	803.00		

*Significant at the $p < .0437$ level.

Table 28

Summary of Analysis of Covariance for Woodcock Nonword

Source of Variation	df	Sum of Squares	F	p
Nonword Reading pretest	1	1372.15	73.08	.000*
Group (computer, teacher control)	2	101.57	2.70	.075
Error	60	1126.52		

*Significant at the $p < .0437$ level.

Table 29

Summary of Analysis of Covariance for Nonword Total

Source of Variation	df	Sum of Squares	F	p
Nonword Total pretest	1	6292.49	179.29	.000*
Group (computer, teacher control)	2	119.68	1.70	.190
Error	60	2105.84		

*Significant at the $p < .0437$ level.

children's performance on these dependent measures indicate no effects for group on these skills.

Table 30 presents the results of the interaction model for the real word measure. The main significant finding was a lower slope for the computer group. In this group students higher at pretest on real word reading tended to perform less well at posttest than those with initially lower ability on this measure.

Table 30

Summary of the Interaction Model for the Real Word Measure

Variable	Parameter	t	p
Constant	2.234	1.125	0.265
Pretest	1.370	11.557	0.000
Teacher Group	-0.171	-0.061	0.952
Computer Group	2.038	0.812	0.420
Pre*Teacher	-0.190	-1.103	0.274
Pre*Computer	-0.334	-2.303	0.025*

*Significant at the $p < .0437$ level.

Results of the planned orthogonal contrasts. Planned comparisons are appropriate when hypotheses underlying these comparisons have been planned before the study is conducted, and strong theoretical and empirical bases exist for specifying these hypotheses (Shavelson, 1988). Each comparison must be independent of every other comparison in

that it must provide nonoverlapping information with other comparisons. Under these conditions, the t -test is used to examine the hypotheses statistically. In this study two independent orthogonal comparisons were planned for each dependent variable.

The first contrast compared the averaged posttest performance of the two intervention groups (computer-assisted and teacher-led) with the posttest performance of the no intervention control group. Results of this analysis indicated a significant difference between the performance of the children in the two intervention groups when compared to that of the control group on the measure of segmentation ($t = 2.40336$, $p = 0.01935$). There were no significant differences on any of the other dependent measures.

The second contrast compared the posttest performance of children in the computer-assisted group with the posttest performance with those in the teacher-led group. There were no significant differences on any of the dependent measures between these groups.

Summary

The results of the statistical analyses of the data from this study have been presented in this chapter. Methods employed to ensure the reliability of instructional and measurement procedures were described and demographic data presented to demonstrate the initial equivalency of intervention groups. The statistical models used to analyze the data were explained, and the results of the data analysis

were examined. Results of the data analysis showed participants in all groups made significant progress on all but one measure from pretest to posttest. There was a significant effect for group for the teacher-led intervention for the dependent measure of segmentation. When the segmentation performances of the computer-assisted group and the teacher-led group were averaged together and this averaged mean statistically compared with the control group mean, a statistically significant difference was noted in favor of the instructed groups. There were no other statistically significant differences.

CHAPTER V DISCUSSION

Two decades of research have confirmed that phonological awareness plays a crucial role in the development of reading ability (e.g., Adams, 1990; Stanovich, 1986, 1988; Torgesen et al., 1990; Vellutino & Scanlon, 1987; Wagner & Torgesen, 1987; Wagner et al., 1994). Neurobiological findings support the existence of a causal link between phonological awareness and reading (Galaburda & Geschwind, 1985; Lyon, 1995). Genetic studies suggest that phonological awareness may be influenced by heredity (Lyon, 1995). Taken together, experimental, intervention, neurophysiological, and genetic findings support a phonological model of beginning reading (Adams, 1990). This model provides a conceptual framework that demonstrates how phonological processing affects reading and the importance of phonological instruction to acquiring beginning reading skills.

Because of the established relationship between phonological awareness and beginning reading achievement, instruction in phonological awareness is critical in the primary grades. Developmental evidence indicates that younger children have fewer phonological skills than older children and that poor readers have fewer phonological skills than good readers, regardless of age (Smith, 1995; Stanovich

et al., 1988). Construct validation evidence (McBride-Chang, 1995; Wagner et al., 1993; Yopp, 1988) suggests that more than one phonological skill may significantly affect reading performance, and analysis (segmentation) and synthesis (blending) have been identified as distinct but correlated abilities composing phonological awareness.

In the present research, training study evidence was reviewed to identify those interventions that have proven most successful in increasing phonological and reading skills in poor readers. This evidence indicated that both blending and segmentation skills are necessary to affect reading (for example, O'Connor et al., 1993; Slocum et al., 1993; Torgesen et al., 1992). Training study literature also indicated that explicit or direct instruction was most often used in studies resulting in positive effects on phonological awareness and reading skills (Fox & Routh, 1984; O'Connor et al., 1996; Weiner, 1994).

Though direct, explicit instruction appears necessary for children who have not developed phonological awareness, challenges were identified that affect the delivery of this type of instruction in regular classrooms. Providing explicit instruction that is well planned, interactive, and closely monitored requires teacher time spent in planning and managing instruction for children who may represent only a small percentage of the total classroom group. Children do not necessarily master skills as a group, and providing for the needs of children who learn at slower rates can be

difficult in diverse classrooms. Lack of teacher time, insufficient training, and untested materials can all affect the ability of the teacher to deliver appropriate instruction to children at risk for reading failure.

Computer-assisted instruction in phonological awareness has been proposed as a more viable alternative to classroom teachers than direct instruction (Torgesen & Barker, 1995). Computer-assisted instruction has been effective in teaching a variety of reading skills (Jones et al., 1987; Leong, 1995; van Daal & Reitsma, 1990; Wise & Olson, 1994), including those subsumed under phonological awareness (Barker & Torgesen, 1995; Foster et al., 1994; Uhry & Shepherd, 1993). Until the present study, however, no research existed on whether computer-assisted instruction is as effective in increasing phonological and reading skills as teacher-led instruction.

The purpose of the study was to compare the effects of computer-assisted instruction, teacher-led instruction, and no instruction on the phonological skills of children with deficits in phonological awareness. The same phonological skills were taught in each treatment group. Other variables (such as duration, stimulus words, and reinforcement) were identical. The salient difference between the two intervention groups was the medium of instructional delivery. By comparing the results of computer-delivered and teacher-led instruction, it was hoped that conclusions could be drawn about the relative effectiveness of each form of

intervention. If children learned skills equally well or better when instructed by computer, teachers might feel confident in providing computer-assisted instruction as a method for increasing phonological awareness.

The objectives of the study were as follows:

1. To determine if instruction in phonological awareness skills increases these skills in children with delayed development of phonological awareness.
2. To determine if instruction in phonological awareness skills increases the reading skills of children with delayed development of phonological awareness.
3. To determine if computer-assisted instruction is as effective as teacher-led instruction in improving the phonological and reading skills of children who demonstrate delayed development of phonological awareness.

This study was conducted using a pretest-posttest experimental group design. Children in Group A received computer-assisted instruction in phonological awareness skills. Children in Group B received direct instruction in phonological awareness skills led by graduate student teachers. Children in Group C received no special instruction in phonological awareness skills. Six hypotheses regarding the acquisition of phonological skills in young children were constructed and tested. Dependent measures of instructional effectiveness were statistically examined to compare the effects of group on the phonological awareness and reading skills of first-grade students.

In the following sections, the six hypotheses are examined in light of the results of the statistical analysis described in Chapter IV, and a discussion of the findings and implications of the study is presented. Limitations of the study are acknowledged, and suggestions for future research are proposed.

Summary of the Hypotheses and Results

Six hypotheses were constructed to test the effects of group on the phonological and reading skills of participants. The results of the statistical analyses designed to test each hypothesis are discussed in this section.

Hypothesis 1

There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no phonological awareness instruction on measures of phonological awareness skills, including phoneme blending, phoneme segmenting, and phoneme elision.

The ANCOVA revealed a statistically significant difference for the dependent measure of segmentation. Planned comparisons indicated the averaged pretest-to-posttest gains of the two training groups were significantly higher than that of the no intervention control group on this measure. Thus, for the phonological measure of segmentation, statistical analysis resulted in rejection of the null hypothesis.

No significant difference was indicated between those who received instruction in phonological awareness (Groups A

& B) and those who received no instruction in phonological awareness (Group C) on the phonological measures of blending or elision, resulting in a failure to reject the null hypothesis for these measures.

Hypothesis 2

There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no phonological awareness instruction on standardized measures of nonword reading.

No significant difference was indicated between those who received instruction in phonological awareness (Groups A & B) and those who received no instruction in phonological awareness (Group C) on a standardized measure of nonword reading. The lack of a statistically significant difference resulted in a failure to reject the null hypothesis.

Hypothesis 3

There will be no statistically significant difference between students receiving phonological awareness instruction and those receiving no phonological awareness instruction on a standardized measure of word reading.

No significant difference was indicated between those who received instruction in phonological awareness (Groups A & B) and those who received no instruction in phonological awareness (Group C) on a standardized measure of real word reading. An interaction effect was noted on the real word reading measure, suggesting that children in the computer group who performed at higher levels than controls on this

measure at pretest performed lower than controls at posttest. The lack of a statistically significant difference resulted in a failure to reject the null hypothesis.

Hypothesis 4

There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on measures of phonological awareness skills, including phoneme blending, phoneme segmenting, and phoneme elision.

No significant difference was indicated between those who received computer-assisted instruction in phonological awareness (Group A) and those who received teacher-led instruction in phonological awareness (Group B) on the phonological measures of segmentation, blending, or elision, resulting in a failure to reject the null hypothesis for these measures.

Hypothesis 5

There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on standardized measures of nonword reading.

No significant difference was indicated between those who received computer-assisted instruction in phonological awareness (Group A) and those who received teacher-led instruction in phonological awareness (Group B) on standardized measures of nonword reading. The lack of a

statistically significant difference resulted in a failure to reject the null hypothesis.

Hypothesis 6

There will be no statistically significant difference between students receiving computer-assisted instruction and those receiving teacher-led instruction on a standardized measure of real word reading.

No significant difference was indicated between those who received computer-assisted instruction in phonological awareness (Group A) and those who received teacher-led instruction in phonological awareness (Group B) on a standardized measure of real word reading. An interaction effect was noted on the real word reading measure, suggesting that children in the computer group who performed at higher levels than controls on this measure at pretest performed lower than controls at posttest. The lack of a statistically significant difference resulted in a failure to reject the null hypothesis.

Summary

Six hypotheses regarding the acquisition of phonological and reading skills for children with delayed development phonological awareness development were tested using statistical analysis. A statistically significant difference was indicated on one measure of phonological awareness (segmentation) for the intervention groups (Groups A and B) relative to the control group (Group C). Lack of statistically significant posttest differences between those

receiving instruction in phonological awareness (Groups A and B) and those receiving no instruction in phonological awareness (Group C) was noted for the phonological measures of blending and elision and the standardized measures of nonword and real word reading. Lack of statistically significant posttest differences between those receiving computer-assisted instruction in phonological awareness (Group A) and those receiving teacher-led instruction in phonological awareness (Group B) was noted for all measures.

Discussion

In this section, the findings of the study are compared with the findings of prior research in phonological awareness. Several areas of discontinuity between the results of this study and previous research are reported. Tentative explanations for the inconsistencies between the results of this study and prior research are explored.

Areas of Congruence with Previous Research

In this study, differences at posttest were evaluated by comparing (a) the averaged performance of the intervention groups (Groups A and B) with the control group and (b) computer-assisted instruction (Group A) with teacher-led instruction (Group B). Results are in agreement with prior research on one dependent measure. Statistical results provided evidence that intervention was effective in improving segmentation ability. This result is consistent with results of previous intervention studies (Davidson & Jenkins, 1994; Fox & Routh, 1984; O'Connor et al., 1993;

Slocum et al., 1993). In approximately 88% of studies of the effectiveness of phonological awareness intervention, children showed significant increases in the ability to perform segmentation tasks.

Areas of Contrast with Previous Research

The results of this study are not in agreement with prior research investigating the effectiveness of phonological awareness interventions on skills involving blending, elision, nonword reading, and real word reading. The first comparison (Group A and B to Group C) indicated no significant differences in pretest-to-posttest gains between children who received phonological awareness instruction and those who received no special instruction on measures of blending or elision. Previous research (Davidson & Jenkins, 1994; Torgesen et al., 1992; Torneus, 1984) indicated significant effects resulted from blending instruction. In approximately 84% of the studies reviewed for this research in which the blending skill was taught, a dependent measure of this skill showed significant increases in the ability to perform blending tasks. In approximately 80% of the studies reviewed for this research in which the blending or segmentation skill was taught, significant increases in the elision skill were indicated by posttest measures.

With regard to nonword and real word reading, the planned comparison indicated no differences relative to the control group for children who received phonological instruction (computer-assisted and teacher-led group means

averaged together) for the nonword reading tasks. An interaction effect was noted on the real word reading measure, suggesting that children in the computer group who performed at higher levels than controls on this measure at pretest performed lower than controls at posttest. This result is not in agreement with previous research (Barker & Torgesen, 1995; Byrne & Fielding-Barnsley, 1993; Cunningham, 1990; McGuinness, McGuinness, & Donohue, 1995). In approximately 95% of studies investigating the effectiveness of phonological awareness interventions, dependent measures of reading showed significant increases in nonword and real word reading skills.

In summary, it is difficult to draw conclusions concerning the effectiveness of phonological awareness instruction because the results of this study are inconsistent with prior research. Consistent with expectations based on previous research, instruction in phonological awareness resulted in significantly higher increases in segmentation skills when compared to the control group. However, in contrast to the results of previous research, the intervention groups (Groups A and B) did not make significantly greater progress than controls on any other dependent measure. All groups made significant progress on all measures pretest to posttest (except for the computer-assisted group on one measure of nonword reading). Two factors that may have influenced results of the present study are (a) classroom reading instruction and (b) transfer

of learning. In the following sections, these issues are explored.

Classroom Reading Instruction

A possible explanation for the lack of posttest differences on the blending measure may be that all study participants were receiving instruction in this skill in their classrooms. The difficulty of isolating the effects of phonological interventions from the effects of classroom reading instruction has been noted by several researchers (Ball & Blachman, 1991; Bentin & Leshem, 1993; O'Connor & Jenkins, 1995; Weiner, 1994). The comparatively high initial performance of study participants on the blending pretest measure (mean = 16.56 for study participants versus 14.75, the norm for grade 1) indicates that these children may have been receiving instruction in blending prior to the beginning of this study. Reading instruction varied across schools and classrooms, but in each school the reading curriculum included the teaching of phonics, a method of reading instruction in which letter-sound correspondences are memorized, and children practice blending the sounds together to read words.

Transfer of Learning

Children with high-risk characteristics may differ from typical learners in their ability to transfer phonological awareness skills across tasks. The failure of a significant proportion of children with diverse learning characteristics to transfer learning has been noted by researchers (Davidson

& Jenkins; 1994; Hohn & Ehri, 1983; O'Connor et al., 1993; O'Connor et al., 1995; Olofsson & Lundberg, 1985; Slocum et al., 1993; Torgesen et al., 1992).

Transfer of learning is the occurrence of relevant behavior under different, nontraining conditions (for example, across tasks, settings, behaviors, or time) (Stokes & Baer, 1977). Transfer of learning occurs when instruction in one skill improves performance in a related, uninstructed skill. Some research suggests that children at risk for school failure because of reading or other learning disabilities have difficulty transferring their learning (Alley, Deshler, Clark, Schumaker, & Warner, 1983; Day & Zajakowski, 1991).

Although the phonological awareness literature is inconsistent on the issue of learning transfer, in the present study, children instructed in blending and segmentation failed to demonstrate transfer to additional phonological and reading tasks. Children were expected to accomplish two aspects of learning transfer relevant to phonological instruction: (a) transferring blending and segmenting skill to the task of elision and (b) transferring phonological skills to reading tasks. While the blending and segmentation tasks were directly practiced in both interventions, the elision task was not. Transfer of segmentation skill to the task of elision was required. The elision task required children to segment a word, hold this information in memory, and perform the required deletion.

The elided form of the word was produced orally. Though all children improved significantly on this skill from pretest to posttest, there were no significant differences in gains for children who received phonological instruction and those who received no special instruction in phonological awareness. Failure to transfer blending and segmenting skill to elision was indicated by lack of statistically significant differences at posttest between the intervention groups and the control group.

Failure to transfer phonological skills to reading tasks was also indicated by lack of statistically significant differences between groups. As with the elision task, nonword and real word reading tasks were not directly practiced in the interventions. Transfer of phonological learning was required. Though high levels of blending ability existed at pretest, and posttest results showed significant gains in segmentation for the intervention groups, a significant transfer effect to reading, as measured by nonword and real word reading tasks, was not indicated.

In summary, failure to transfer learning has been noted in interventions for children with reading and other disabilities. In the present study, children in the intervention groups had initially high levels of blending combined with significantly higher posttest gains on segmentation, yet they were unable to transfer this learning to the task of elision. Because the existing body of research indicated a causal relationship between phonological

awareness and reading, the intervention groups were expected to have significantly higher pretest to posttest reading gains as well. This transfer of skills did not occur.

Two types of transfer are relevant to the current study. They are (a) transferring skill in one phonological task to a second, uninstructed phonological task and (b) transferring one or more phonological skills to reading tasks. Both types of transfer have been investigated in intervention research with at risk children.

Transfer among phonological skills. Researchers have been unable to determine definitively from phonological awareness studies if children taught one phonological skill can transfer their learning to a second phonological skill. Some studies found that children at risk because of reading or other disabilities have shown difficulty in this type of transfer. O'Connor et al. (1993) taught blending and segmenting to 35 Head Start preschool children and found no evidence of transfer across phonological tasks. Slocum et al. (1993) taught blending to one group and segmenting to a second group. Subjects were 35 prekindergarten children with low receptive language. Slocum et al. concluded that there was no indication of transfer across these phonological tasks. Two additional studies have corroborated these findings. Torgesen et al. (1992) found that teaching blending to children with low phonological awareness did not transfer to skill in segmentation. Additionally, Davidson and Jenkins (1994) taught blending and segmentation to 40

kindergarten children with low phonological awareness. Results indicated that when children were taught either blending or segmenting, they were unable to transfer their learning to the other phonological task.

On the other hand, transfer to the elision task has been noted in two studies involving high-risk students (O'Connor et al., 1995; Vandervelden & Siegel, 1995). O'Connor et al. divided 67 kindergarten children with low phonological awareness (language delayed, special education, or special education referred students) into three treatment groups. One group received blending and segmentation plus letter-sound instruction. The second group received the same instruction with the addition of phonological tasks such as syllable deletion and rhyming. The third group received letter-sound training only. Training took place in 15-minute sessions twice a week for 10 weeks. Results indicated no significant differences for the group taught blending and segmentation and the group taught additional phonological awareness skills on the Lindamood Auditory Conceptualization test (Lindamood & Lindamood, 1979), which included a measure of elision. Both performed significantly better than the letter-sound only group. The authors concluded that children who learn segmentation and blending have sufficient phonological skill to transfer to other phonological awareness tasks.

In the Vandervelden and Siegel (1995) study, 30 kindergartners (including 22 with low phonological awareness)

received instruction in segmentation, blending, and spelling in two groups. One group practiced these skills within the context of reading instruction, and the second group received no practice in applying phonological skills in context. The group receiving practice in contextual application showed significantly higher gains on a measure of deletion, an elision task, than those who received no contextualized practice.

Transfer of phonological skills to reading. The second area where current literature is inconsistent on transfer of learning is in the transfer of phonological skills to reading tasks. Six studies measuring the transfer abilities of students with low phonological awareness abilities or learning disabilities suggest that intervention in phonological awareness assists these children in improving decoding of nonwords and real words (Barker & Torgesen, 1995; Davidson & Jenkins, 1994; Hurford et al., 1994; Torgesen et al., 1992; Uhry & Shepherd, 1993; Wise & Olson, 1995).

Despite the evidence suggesting that transfer from instructed phonological awareness to reading should occur, two studies showed that skill in segmentation did not transfer to improved decoding (Hohn & Ehri, 1983; Olofsson & Lundberg, 1985). Hohn and Ehri divided 24 kindergarten children with low phonological skills into three groups. One group practiced using letter tokens; the other group used blank tiles. Significant effects for both groups on segmentation skills were observed, but no significant

differences were noted on reading measures for either group. Olofsson and Lundberg looked at the long-term effects of phonological awareness training in kindergarten. When the reading performances of trained children were analyzed one year subsequent to the intervention, no significant transfer effects to reading were observed for children in the lower scoring group at pretest.

In summary, the literature on transfer of phonological skills is inconsistent and requires further study. The failure of a significant proportion of children with diverse learning characteristics to transfer learning has been noted by researchers (Davidson & Jenkins, 1994; Hohn & Ehri, 1983; O'Connor et al., 1993; O'Connor et al., 1995; Olofsson & Lundberg, 1985; Slocum et al., 1993; Torgesen et al., 1992; Vandervelden & Siegel, 1995).

Factors affecting transfer. To accomplish transfer of learning, two factors must be present: (a) Students must have developed skills to sufficient levels to allow independent application, and (b) students must recognize that a skill or strategy is appropriate for application in a novel context. The first requirement implies instruction that helps students reach a certain degree of skill mastery (Day & Zajakowski, 1991; Slocum et al., 1993), while the second requirement suggests instruction in the application of skills within appropriate contexts (Cunningham, 1990; Hatcher et al., 1994; Lane, 1994; Vandervelden & Siegel, 1995; Weiner, 1994).

The first requirement, skill mastery, appears to be influenced by duration and intensity of instruction (O'Connor et al., 1995). The duration and intensity of instruction must be sufficient to achieve not only accuracy but fluency. The instructional intervention must continue until students can apply skills correctly and with automaticity. Because children with reading-related and other disabilities may acquire skills more slowly than average, longer, more intense interventions may be required to ensure that children not only acquire target skills but also practice them until they are fluent and automatic.

Sufficient fluency and automaticity may not have been achieved by the at-risk children in some short-term studies (O'Connor et al., 1993; O'Connor et al., 1996; Torgesen et al., 1992). O'Connor et al. (1996) surmised that children with reading disabilities may need longer and more intense instruction than the 5- to 15-minute sessions provided in their study. Torgesen et al. (1992) suggested that these children might benefit from more intensive interventions such as those that provide one-on-one instruction in phonological awareness and extend over many months. Little is presently known about the length, intensity, and timing of treatment that is necessary to affect reading (Blachman, 1994).

At-risk children in the present study used programs (DaisyQuest, 1993; Daisy's Castle, 1993) that included a fluency component. In these programs, as children progress through the seven skill strands a second time, they must

respond correctly within 8 seconds to achieve mastery. Subsequent progressions allow 4 seconds response time. In the present study, most children in the computer-assisted group did not progress beyond the 8-second response level, and this level may not have been sufficient to develop mastery. Fluency in the teacher-led group was ensured by a signaling procedure which required that students respond within 1 to 2 seconds. If all children did not respond correctly and on signal, the teacher repeated the stimulus presentation and signal. The group progressed to the next practice item only when each child demonstrated accuracy and fluency on the previous item. Individual children were given extra turns to respond as necessary.

Despite interventions designed to promote fluency, the duration of the intervention period may not have been of sufficient length to allow students to achieve a level of mastery sufficient to promote transfer. While the duration (24 sessions over 6 weeks) was comparable to the length of previous phonological awareness interventions that were successful with high risk learners (Barker & Torgesen, 1995; Foster et al., 1994; Hurford et al., 1994), lack of significant differences between groups on phonological or reading measures suggests that longer interventions may be necessary for high-risk children to develop a level of mastery with instructed skills that allows transfer of learning.

The second requirement for transfer of learning, application in the appropriate context, has received some attention in recent research. Instruction within the context of reading connected text has been successful with average-achieving children in helping them transfer phonological knowledge to reading tasks. In a 10-week intervention (Cunningham, 1990), children (kindergarten and first grade) received explicit instruction in the application of phonological awareness skills and discussed how and when to use the skills while reading stories. A comparable group of children learned phonological awareness skills by the isolated skills practice method. These children received no instruction within the context of reading. Six months subsequent to the intervention, both groups displayed a significant improvement in reading; however, the degree of improvement depended upon the type of instruction received. Those who were helped to think about the value of phonological awareness skills and their application to reading made greater gains on a reading achievement test than those who received no contextual application.

Instruction in applying phonological skills in context has also been effective with lower achieving children. Hatcher et al. (1994) taught phonological skills to 6- and 7-year-old children scoring poorly on a screening test of word recognition. The study compared the relative effects of phonological awareness skills training combined with reading instruction to the effects of reading instruction alone and

phonological awareness instruction alone. The children who practiced phonological awareness skills in the context of reading showed significant gains on reading skills 9 months after intervention. Lane (1994) taught children with low phonological awareness in two groups. One group practiced phonological skills within a story context. The other group practiced the same phonological skills, but without application within a story context. Data analysis revealed that for the lower achieving children, those who practiced skills within the story context made significant gains compared to those taught with no contextual application on two measures, total phonological skills and reading comprehension. Vandervelden and Siegel (1995) also investigated the effects of teaching phonological skills within the context of reading. They provided identical instruction in phonological awareness for two groups with low phonological awareness. One group practiced applying the skills within the context of reading and spelling activities. The second group received no practice in context. Results indicated significant progress on all measures for the group taught within the context of reading.

In contrast to the studies suggesting that training in contextual application of phonological skills is effective for children at risk because of low reading performance, Weiner's research (1994) indicated that training providing children with a conceptual connection between phonemic skills and reading was generally less effective for low readers. In

this study, low achievers made significantly higher gains on phonological and reading comprehension measures when instructed in phonological skills without contextual application to reading.

Because these studies are few in number and have yielded inconsistent results, the question of the importance of practice in the contextual application of phonological skills is yet to be answered. The majority of studies seem to indicate the importance of metacognitive instruction where children are taught how and when to apply their phonological skills in reading new words. It is also possible that for children to benefit from such instruction, they must have reached a certain mastery level of phonological skills (Weiner, 1994), but little is known about the degree of accuracy and fluency this may require and whether this varies from child to child.

Summary of transfer of learning. In the present study, lack of learning transfer is not entirely surprising in light of inconsistencies in current studies of the transfer performance of children with disabilities. The literature is inconsistent in two areas relevant to the transfer of phonological skills: (a) transferring skill in one phonological task to a second, uninstructed phonological task and (b) transferring skill with one or more phonological skills to reading tasks. Both types of transfer have been investigated in intervention research with at-risk children. To achieve transfer of learning, students must (a) develop

skills to sufficient levels to allow independent application and (b) recognize that a skill or strategy is appropriate for application in a novel context. The first requirement implies instruction that helps students reach a certain degree of skill mastery, while the second requirement suggests instruction in the application of skills within appropriate contexts.

Limitations of the Study

Findings of this study are specific to the subjects and tasks employed. Subjects were first-grade students who attended three elementary schools in north central Florida. Children were instructed in phonological skills in the second half of the school year. The computer-assisted group used a specific software program described in Chapter III, and results for this group may not be generalizable to other software programs. The teacher-led instruction took place outside the classroom, and the results for this group may not be generalizable to instruction that takes place within the classroom environment. Results of the study may also be confounded by the effects of reading instruction children received in the classroom. No longitudinal assessments were conducted, and the long-term effects of the interventions are not known.

Questions to Guide Future Research

Though two decades of research have confirmed that phonological awareness plays a crucial role in the development of reading ability, there is still much to be

learned. Neurobiological findings and genetic studies may some day explain the mechanisms by which structural and functional anomalies in the brain are related to dyslexia and other cognitive disorders. New knowledge may lead to early diagnosis and treatment before children ever enter school. At present, we know that some level of phonological awareness is necessary for children to profit from reading instruction. What these levels are, how they may vary across individuals, and how best to achieve transfer across skills must be further investigated. We need to know the combination of student abilities, phonological skills, and instructional methods that result in effective phonological interventions. The present research suggests the following areas that will need to be further investigated.

Characteristics of Study Participants

Future research should be directed toward refining interventions with respect to the diverse characteristics of learners. In the present study, interventions to increase the phonological skills of children with delayed phonological awareness were not wholly successful in increasing their phonological and reading skills. Interventions were based on the results of prior research, yet much of this work was done with children described as average learners. In many studies participants were not fully described. It is not enough to know an intervention was effective; we must also be able to discern for whom the treatment worked. There is little doubt that individual differences among children interact with the

effects of teaching. Different instructional interventions are likely differentially effective for children with reading and other disabilities as opposed to children who are typical learners. The effects of phonological skills instruction for children with mild disabilities may differ from those found for children who are low achievers.

One step in accomplishing the goal of designing effective interventions for children with disabilities would be to more fully define the participants in intervention research. Research lacking adequate descriptions of subjects is difficult to evaluate (Rosenberg et al., 1994). Research with better-defined subjects will be necessary if we are to learn more about how various phonological awareness interventions affect different learners. Guidelines for reporting descriptive variables for research subjects call for including gender, age, race, socioeconomic status, IQ, achievement, type of educational placement, and school districts' placement criteria (CLD Research Committee, 1984).

Accurate Assessment of Phonological Skills

Accurate assessments of phonological and reading skills must be reported. Information should include the validity and reliability of the instruments used. It is difficult to compare results across studies when researcher-constructed, nonstandardized measures are used to describe performance. Though phonological awareness is a relatively new research area, the development and field testing of phonological measures should receive more attention. In the present

study, the phonological and reading measures were developed and field tested by Drs. Torgesen and Wagner. Though more extensive norming needs to be done, they represent a start at developing instruments that could allow comparisons across studies to be made.

Specific Phonological Skills that Affect Reading

The specific skills necessary to affect reading must be identified. In particular, the skills necessary to bring low-skilled children to the level of their higher performing peers must be delineated. Though some research has suggested that the skills of blending and segmentation are sufficient to affect reading (O'Connor et al., 1995), the research is far from conclusive. In the present study, instruction in rhyming, blending, and segmentation resulted in significant within group pre- to posttest increases in phonological awareness and reading. The intervention groups made significant gains compared to the control group on segmentation but not on blending, elision, or reading tasks. Would direct instruction in the skill of elision have resulted in significant increases in that skill? If children in the teacher-led group had made significant gains on both segmentation and elision, would they also have demonstrated significantly higher effects than controls on reading measures? Multiple baseline studies can be designed to answer these questions. Introducing a sequence of phonological skills over time can pinpoint the exact skills

or combination of skills that must be taught to affect reading.

Factors Affecting Transfer of Phonological Skills

We must investigate the factors that promote transfer of phonological knowledge to reading tasks. In this chapter, factors identified as promoting transfer of learning were (a) mastery level and (b) contextual application. We need to determine the levels of accuracy and fluency necessary to achieve mastery and the duration and intensity of phonological interventions that develops these levels. We must continue to study the effects of interventions providing contextualized application of phonological skills. A multiple baseline design would allow the successive introduction of variables affecting transfer in a systematic and informative way.

The Influence of Classroom Reading Instruction

The interaction between instruction in phonological skills and reading instruction in the classroom should be explored. Clinical experiments that control for outside exposure will be necessary to learn whether gains are partially due to exposure to specific types of classroom activity, such as rhyming or reading instruction that includes blending. In the present study, children receiving phonics instruction in their classrooms exhibited high levels of blending ability at pretest. Many activities common to elementary classrooms heighten phonological awareness (Griffith & Olson, 1992). Some researchers believe that

phonological and reading skills are reciprocal once reading instruction begins (Perfetti, Beck, Bell, & Hughes, 1987). Identifying the components of phonics-based instruction that interact with phonological skills instruction would be useful.

Long-term Effects of Phonological Awareness Instruction

The long-term effects of instruction in phonological awareness should receive more attention. Specifically, it is not known whether a year or more later phonological awareness training has a lasting (or delayed) effect on reading ability because most studies have been conducted over a short period of time. In the present study, children in the intervention groups made significant gains over the control group in segmentation. Information concerning the maintenance of this advantage and whether there was a significant effect in later reading development would be informative. Longitudinal research is demanding of time and financial resources, yet this kind of work is the only way to assess the long-term effects of phonological awareness interventions.

Components of Effective Computer-assisted Phonological Awareness Instruction

The question of the effectiveness of computer-assisted instruction in phonological awareness needs further investigation. If students with diverse learning characteristics require instruction in the application of phonological skills in the context of reading connected text, programs must be designed to incorporate these components.

Designing such programs would be a worthwhile endeavor for interested researchers.

Summary

Six hypotheses regarding the acquisition of phonological and reading skills for children whose delayed development of phonological awareness places them at risk for reading failure were tested using statistical analysis. Results are in agreement with prior research on the dependent measure of segmentation. The results of this study are not in agreement with prior research on the phonological measures of blending and elision or the nonword or real word reading measures. Two factors that may have influenced the unexpected results of the present study are (a) methods of classroom reading instruction and (b) failure to transfer learning. Classroom reading instruction was sufficient for the control group to achieve progress comparable to the intervention groups, but it was not sufficient to enable these children to perform at reading levels commensurate with norms for first-grade peers. To achieve transfer of learning, students must develop skills to a level of mastery that will allow their accurate and fluent application. Factors such as the duration and intensity of interventions affect the degree of mastery attained. Students must also recognize that a skill or strategy is appropriate for application in a novel context. Metacognitive instruction and practice in applying phonological skills with connected text may enable children

to transfer improved phonological awareness to improvement in reading skills.

APPENDIX A
PARENTAL INFORMED CONSENT

February 24, 1997

Dear Parent:

I am a graduate student in the Department of Special Education at the University of Florida under the supervision of Dr. Cecil Mercer. As part of my dissertation research, I need to gather information on reading skill instructional techniques for phonological awareness. Phonological awareness, or the sensitivity to or awareness of the sound structure of language, has been shown to be closely linked with reading ability. Students who receive training in phonological awareness tend to have gains in their ability to sound out words. I am asking your permission to include your child in my study.

I will need to administer the following instruments as part of the study:

1. One test will measure verbal ability or vocabulary knowledge. The child is presented with a series of picture sets and asked to identify which picture in each set goes best with a given word.
2. A second test will measure word attack (sounding out) skills.
3. Several short activities will measure phonological awareness. In these activities, the child will be asked to blend sounds together to form a word or to separate, delete, or match sounds in words.

Participants in this study will be assigned to one of three treatment groups. Participants in group A will work individually on computers, and participants in group B will work in groups of three to six with a graduate student trainer. Both groups will practice blending, segmenting, and rhyming tasks. Participants in Group C will receive regular classroom instruction. Should results of the study show the computer intervention is effective, it will be offered to the students in Group C at the end of the study. The training sessions will take place during the mornings on Mondays, Tuesdays, Thursdays, and Fridays for 25-30 minutes a day. Training will begin on March 3 and continue through May 10.

The training sessions will not interfere with other regular instruction. The trainers will be graduate students from the College of Education at the University of Florida.

Though the results of this study may be shared with educational professionals, all information (whether individual or group) will be held confidential to the extent provided by law, and no child-specific information will be shared with persons other than a child's parents or teachers.

We hope that participation in this training will benefit your child by increasing his/her phonological awareness and, therefore, his/her ability to sound out words while reading. There are no risks associated with this type of training. Participation or nonparticipation in this study will not affect your child's grade in any way. No compensation will be awarded other than stickers on a progress chart, which students will be allowed to keep at the conclusion of the training.

You, as parent or guardian, and your child have the right to withdraw permission for your child's participation at any time during the study, without consequence. If you allow your child to participate in this study, please discuss with him/her that researchers from UF will be coming to his/her school beginning on March 3 and that it is okay with you if he/she wants to work with us.

If you have any questions regarding any portion of this study, please feel free to contact me at 392-5874. Thank you for your consideration. Questions or concerns about research participants' rights may be directed to the University of Florida Institutional Review Board office at 392-0433.

Sincerely,

Penny Travis, M.Ed.

Clip and retain this portion for future reference.

Return this portion to your child's teacher by Friday,
February 28, 1997.

I have read and received a copy of the procedure above. I agree to allow my child, _____ to participate in Penny Travis's phonological awareness study.

Parent/Guardian Signature

Date

Second Parent/Witness

Date

APPENDIX B
PHONOLOGICAL AWARENESS INSTRUMENTS

Blending

- CEILING: Stop when child misses 5 items in a row.
- NOTE: Say sounds at rate of 2 per second on all items. If the child asks you to repeat the sounds, you may do so.
- PROMPT: If the child says the sounds separately (e.g., m-e rather than me), prompt by saying, Try to say the sounds altogether as a real word. This prompt may be used as often as needed on practice items only.
- DIRECTIONS: For this task, I'm going to say a word in small parts. I will say one part of the word at a time. I want you to listen carefully, then put the parts together to make a whole word. Ready? Let's try one.
- What word do these sounds make? 'can-dy'
- If correct: That's right. Let's try the next one.
- If incorrect: That's not quite right. When you put 'can-dy' together, it makes 'candy.' Let's try the next one.
- PRACTICE ITEMS (continue to give corrective feedback as above:

Correct (+/-)
response:

- | | | | |
|----|---------------------------------|--------|------------|
| a. | What word do these sound make? | hammer | _____ |
| | hamm-er | | |
| b. | What word do these sounds make? | d-og | dog _____ |
| c. | What word do these sounds make? | b-all | ball _____ |
| d. | What word do these sounds make? | n-o | no _____ |
| e. | What word do these sounds make? | m-a-n | man _____ |

DIRECTIONS: Let's try some more words. Each time,
I will say a word one part at a time.
Listen carefully and put the parts
together to make a whole word.

TEST ITEMS (provide no more feedback)	Correct response:	(+/-)
1. pen-cil	pencil	_____
2. num-ber	number	_____
3. happ-y	happy	_____
4. c-at	cat	_____
5. d-oll	doll	_____
6. t-oy	toy	_____
7. i-f	if	_____
8. b-ig	big	_____
9. sh-e	she	_____
10. s-aw	saw	_____
11. f-a-s-t	fast	_____
12. wh-i-ch	which	_____
13. j-u-m-p	jump	_____
14. w-a-sh	wash	_____
15. l-i-k	like	_____
16. m-oo-n	moon	_____
17. c-o-l-d	cold	_____
18. d-i-ff-er-e-n-t	different	_____
19. c-ir-c-u-s	circus	_____
20. m-i-s-t-a-k	mistake	_____
21. g-r-a-s-s-h-o-p-p-er	grasshopper	_____
22. a-l-m-o-s-t	almost	_____
23. s-o-m-b-o-d-y	somebody	_____
24. m-o-t-o-r-c-y-k-l	motorcycle	_____
25. b-a-m-b-oo	bamboo	_____
26. t-e-l-e-ph-o-n	telephone	_____
27. m-a-th-e-m-a-t-i-c-s	mathematics	_____
28. u-n-d-e-r-s-t-a-n-d	understand	_____
29. p-r-e-s-i-d-e-n-t	president	_____
	Score	_____

Segmenting

CEILING: Stop when a child misses 5 items in a row.

DIRECTIONS: I am going to say a word. I want you to break the word apart and say it sound by sound. Say each sound you hear in the order that you hear it. For example, if I say DAY, you would say it sound by sound, D-AY. Now you say the word DAY sound by sound.

If correct: That's right. You have the idea. Let's try the next one.

If incorrect: That's not quite right. To say DAY sound by sound, say D-AY. Let's try the next one.

PRACTICE ITEMS (continue corrective feedback)

Remember, I will say a word, then you say it sound by sound.

	Correct response:	(+/-)
a. no	n-o	_____
b. it	i-t	_____
c. pie	p-i	_____

Let's try a few more. I will say a word, then you say it sound by sound.

TEST ITEMS (no feedback)

1. go	g-o	_____
2. do	d-oo	_____
3. me	m-e	_____
4. hi	h-eye	_____
5. up	u-p	_____
6. to	t-oo	_____
7. in	i-n	_____
8. ate	ay-t	_____

Now we are going to do some words that have more sounds in them. Let's try a few for practice. (give corrective feedback as on previous practice items)

PRACTICE ITEMS

a. man	m-a-n	_____
b. good	g-oo-d	_____
c. winner	w-i-nn-er	_____

TEST ITEMS CONTINUED (no feedback)

9.	back	b-a-k	_____
10.	got	g-o-t	_____
11.	pig	p-i-g	_____
12.	beast	b-ee-st	_____
13.	won	w-o-n	_____
14.	runner	r-u-nn-er	_____
15.	jump	j-u-m-p	_____
16.	cloth	c-l-o-th	_____
17.	thunder	th-u-n-d-er	_____
18.	person	p-er-s-o-n	_____
19.	important	i-m-p-or-t-a-n-t	_____
20.	neighborhood	n-ai-b-er-h-oo-d	_____
21.	magnify	m-a-g-n-i-f-eye	_____
22.	pleasantly	p-l-e-z-e-n-t-l-ee	_____
23.	naturally	n-a-ch-ur-a-l-ee	_____
24.	straighten	s-t-r-ai-t-e-n	_____
25.	occasionally	o-k-ai-zh-u-n-l-ee	_____

Score _____

Elision

PRACTICE: Let's play a word game. Say TOOTHRUSH.
Now say TOOTHRUSH without saying TOOTH.

If correct: That's right. Let's try the next one.

If incorrect: That's not quite right. TOOTHRUSH
without say TOOTH is BRUSH.

CEILING: 5 errors in a row.

PRACTICE ITEMS (continue to give correct/incorrect
 feedback as above)

Let's try some more.

Correct (+/-)
 response:

- | | | |
|---|------|-------|
| a. Say TULIP. Now say TULIP without saying LIP. | TO | _____ |
| b. Say CUP. Now say CUP without saying the /k/ sound. | UP | _____ |
| c. Say MEET. Now say MEET without saying the /t/ sound. | ME | _____ |
| d. Say POUCH. Now say POUCH without saying the /p/ sound. | OUCH | _____ |

TEST ITEMS (no more feedback given):

- | | | |
|---|-------|-------|
| 1. Say COWBOY. Now say COWBOY without saying BOY. | COW | _____ |
| 2. Say APPLESAUCE. Now say APPLESAUCE without saying SAUCE. | APPLE | _____ |
| 3. Say BASEBALL. Now say BASEBALL without saying BASE. | BALL | _____ |
| 4. Say WINDOW. Now say WINDOW without saying DOW. | WIN | _____ |
| 5. Say CARD. Now say CARD without saying the /d/ sound. | CAR | _____ |
| 6. Say HEAT. Now say HEAT without saying the /t/ sound. | HE | _____ |
| 7. Say NO. Now say NO without saying the /n/ sound. | OH | _____ |
| 8. Say BE. Now say BE without saying the /b/ sound. | EE | _____ |
| 9. Say BAT. Now say BAT without saying the /b/ sound. | AT | _____ |
| 10. Say MAN. Now say MAN without saying the /m/ sound. | AN | _____ |
| 11. Say GONE. Now say GONE without saying the /g/ sound. | ON | _____ |

- | | | |
|--|--------|-------|
| 12. Say TIME. Now say TIME without saying the /m/ sound. | TIE | _____ |
| 13. Say SWING. Now say SWING without saying the /w/ sound. | SING | _____ |
| 14. Say STUN. Now say STUN without saying the /t/ sound. | SUN | _____ |
| 15. Say PRANCE. Now say PRANCE without saying the /r/ sound. | PANTS | _____ |
| 16. Say WINTER. Now say WINTER without saying the /t/ sound. | WINNER | _____ |
| 17. Say WALTER. Now say WALTER without saying the /l/ sound. | WATER | _____ |
| 18. Say RASKET. Now say RASKET without saying the /s/ sound. | RACKET | _____ |
| 19. Say TIGER. Now say TIGER without saying the /g/ sound. | TIRE | _____ |
| 20. Say STRAIN. Now say STRAIN without saying the /r/ sound. | STAIN | _____ |
| 21. Say DRIVER. Now say DRIVER without saying the /v/ sound. | DRYER | _____ |
| 22. Say STABLE. Now say STABLE without saying the /s/ sound. | TABLE | _____ |
| 23. Say SILK. Now say SILK without saying the /l/ sound. | SICK | _____ |
| 24. Say SPLIDE. Now say SPLIDE without saying the /p/ sound. | SLIDE | _____ |
| 25. Say TWIKST. Now say TWIKST without saying the /k/ sound. | TWIST | _____ |

Score_____

APPENDIX C
NONWORD READING EFFICIENCY TEST

- Materials:** Stopwatch, Form A, and Practice Form for nonwords.
- Ceiling:** Administer all items.
- Note:** If the child skips a nonword, simply count it as an error. If the child hesitates for more than three seconds on a nonword, point to the next item and say "Go on."
- Scoring:** Some of the items have more than one correct pronunciation. Score the item correct if the child gives any of the correct pronunciations. Alternative correct pronunciations will be indicated with real word examples (for short words), or with pronunciation marks (for long and short vowel forms) above the vowel.

Practice:

Now I want to read some words that are not real words. Just tell me how they sound. I want you to read them as fast as you can. Let's start with this practice list. Just start at the top, and read down the list as fast as you can. If you come to a word you cannot read, just skip it and go on to the next word. You can use your finger to help you keep your place if you want to.

Show the practice list and have the child read the nonwords. If children skip around a lot, ask them to read the words from top to bottom, without jumping around. If they try to substitute real words for the nonwords, remind them that these are made up words, not real words, and they are just to say how they sound.

- Practice words:** **ba** (bat, balk, or fate), **um** (umpire),
 fos (fossil), **gan** (gander), **rup**
 (rupture),

 nasp (clasp), **luddy** (muddy), **dord**
 (ford)

Directions:

OK, now we will read some longer lists of nonwords. The words start out pretty easy, but they get harder as you go along. Just read as many of these nonwords as fast as you can until I tell you to stop. Start up here (point to the

upper left corner on Form A) and read down the list (draw finger down the list) before you start on the next list (point to top of second column). Read the words in order, but if you come to one you can't read, just skip it and go to the next one. Remember, you can use your finger to keep your place if you want to. Do you understand? O.K., you will begin as soon as I uncover the card.

Quickly take cover off card, and start timing as soon as the child says the first nonword. As the child is reading, mark all the words that are correctly read. After 45 seconds, tell the child to stop. The child's score is the total number of nonwords correctly read within 45 seconds. If the child finishes all the nonwords before the time is up, note the time required to read all the words. If, before the time is up, children indicate they cannot read any more words, ask them to look over the whole list to see if there are any more words they can read. If children then indicate they can read no more words, stop the test.

Number of nonwords read correctly in 45 seconds. Form A ____

If child finishes list before 45 seconds,
note time to finish. Form A ____

Child's # _____

Practice Nonwords

ba

um

fos

gan

rup

nasp

luddy

dord

Response form for Nonword Efficiency Task

Please mark all the words the child reads incorrectly on each form and draw a line after the child's last word.

ga (gate, talk, tack)	shlee (flee)	sploosh (loose)
ip (tip)	meest (feast)	dreker (dreker, dreker)
ta (tape, talk, tack)	stip (slip)	nispat (nispat)
ni (nip, nice)	plin (fin)	rimdun (rimdun)
ko (cold, come, to)	skree (tree)	bremick (bremick, bremick)
ig (pig)	frip (trip)	hodfern (hodfern)
om (on)	sline (line)	clabob (clabob, clabob)
pim (him)	guddy (muddy)	brigbert (brigbert)
baf (tack)	dreef (reef)	drepernd (drepernd)
din (fin)	vasp (clasp, wasp)	shrankled (shrankled)
wum (sum)	clirt (shirt)	plotent (plotent, plotent)
lat (fat)	felly (jelly)	smuncrit (smuncrit)
fet (met)	bloot (loot)	pelnador (pelnador, pelnador)
pate (fate)	prain (pain)	fornalask (fornalask)
nup (cup)	zint (lint)	crenidmore (crenidmore)
bave (save)	kelm (helm)	fermabalt (fermabalt)
herm (term)	trober (trober, trober)	embulbatate (embulbatate)
chur (blur)	trijs (brisk)	
dess (mess)	strone (stone)	
knap (nap)	lunap (lunap)	
tive (hive)	depene (depene, depene)	
poth (both, loss)	cratty (fatty)	
barp (tarp)	glant (plant)	

APPENDIX D
WORD READING EFFICIENCY TEST

Materials: Stopwatch, Form A, and Practice Form for real words.
Ceiling: Administer all items.
Note: If the child skips a word, simply count it as an error. If the child hesitates for more than three seconds on a word, point to the next item and say "Go on."

Practice:

Now I want you to read some lists of words as fast as you can. Let's start with this practice list. Just start at the top, and read down the list as fast as you can. If you come to a word you cannot read, just skip it and go to the next word. You can use your finger to help you keep your place if you want to.

Show the practice list and have them read the words. If they skip around a lot, ask them to read the words from top to bottom, without jumping around.

Practice words: on, my, bee, old, warm, bone, help,
spell

Directions:

OK, now we will read some longer lists of words. The words start out pretty easy, but they get harder as you go along. Just read as many words as fast as you can until I tell you to stop. Start up here (point to the upper left corner on Form A) and read down this list (draw finger down the list) before you start on the next list (point to top of second column). Read the words in order, but if you come to one you can't read, just skip it and go to the next one. Remember, you can use your finger to keep your place if you want to. Do you understand? OK, you will begin as soon as I uncover the card.

Quickly take cover off card, and start timing as soon as the child says the first word. As the child is reading, count any words that are misread or skipped. After 45 seconds, tell the child to stop, and note the last word read. The child's score is the total number of words correctly read within 45 seconds. If the child finishes all the words

before the time is up, note the time required to read all the words.

Number of words read correctly in 45 seconds Form A_____

If child finishes list before 45 seconds,
note time to finish. Form A_____

Child's #_____

Practice Real Words

on

my

bee

old

warm

bone

help

spell

Response forms for Word Reading Efficiency

Please mark all the words the child reads incorrectly on each form and draw a line after the child's last word.

Form A

me	kind	finally	courageous
up	long	without	alienate
no	then	strange	putative
he	paper	budget	limousine
to	find	repress	valentine
cat	help	justice	detective
him	father	resolve	recently
yes	open	potent	transient
red	shoes	garment	instruction
leg	money	qualify	avocation
was	great	collapse	residence
new	space	pioneer	obedient
let	short	remember	itinerary
back	river	dangerous	persevere
book	crowd	uniform	rescinded
bus	plot	problems	sympathize
part	overt	absentee	understand
wood	glide	advertise	confident
time	people	pleasant	abdominal
neck	almost	distress	intensity
dear	strong	emphasis	hereditary
able	hardly	plausible	circumstance
fine	flint	extinguish	obligation
date	healthy	recession	aborigine
work	famous	intuition	occasionally
jump	extent	boisterous	emancipate

APPENDIX E
SCRIPTED LESSONS

Script #1

Materials: Teacher's Manual
Memory cards

Teacher: Today we are going to learn about rhyming. I think you are going to like the activity because we will play games. Rhyming is when words end in the same sound. Here is a rhyme: hat (point to picture of hat), bat (point to picture of bat). They both end with the same sound, "at." Some words do not rhyme: sock (point to picture of sock), bat (point to picture of bat). Sock ends in "ock," bat ends in "at." Remember words only rhyme if they end in the same sound. Now it's your turn. I will show you two pictures and you will tell me if the words rhyme. Let's do the first one together. Everyone needs to answer on signal. This is how I signal (teacher taps table). Remember only I signal.

Teacher holds up page #3 with picture of "wing" and "dive."
Teacher points to wing: This is a wing. What is this? (signal)

Students: wing

Repeat procedure until all students are answering on signal correctly.

Teacher points to dive: This is a dive. What is this? (signal)

Students: dive

Teacher: Do the words wing and dive end in the same sound? (signal)

Students: no.

Teacher: Do the words wing and dive rhyme? (signal)

Students: no

Teacher: Correct. Wing and dive do not rhyme because they do not end in the same sound. (Point to "wing") Wing ends in "ing." (Point to dive) Dive ends in "ive."

(Turn to page #4)

Teacher points to jog: This is jog. What is this? (signal)

Students: jog

Teacher point to a dog: This is a dog. What is this?
(signal)

Students: dog

Teacher: Do the words jog and dog end in the same
sound? (signal)

Students: yes

Teacher: Do the words jog and dog rhyme? (signal)

Students: yes

(If students answer incorrectly, repeat the words again.

Remind students that words rhyme if they end in the same

sound. Then ask students, Do these words end in the same
sound? Do these words rhyme?)

Teacher: You've got it. The words jog and dog rhyme
because they end in the same sound. Listen (pause) jog
. . . dog.

(Turn to page #5. Repeat the same procedure for the words:
wave, jog).

(Turn to page #6. Repeat the same procedure for the words:
hop, top.)

Turn to page #7. Repeat the same procedure for the words:
sock, keys.)

Teacher: Wow, you all did an awesome job learning how
to rhyme. Now we are going to play a game called
Memory. (Teacher places memory cards face down on table in
a square.) The first person to play picks up one of
the cards on the table and says the word that picture
shows. If the two words rhyme, he/she gets to keep
that pair of cards. If the words do not rhyme, he/she
must turn both of the cards back over. We are going
to take turns moving around the table until everyone
has a turn. When there are not any cards left, the
person with the most cards wins. (If someone wins,
quickly plan the game again.)

Script #2

Materials: Teacher's Manual

Student Bingo Cards (for each student)
Page of picture cards (for each student)
Glue
Crayons

Teacher: I want to see who can show me what they remember from the last time we were together. Remember, rhyming is when words end in the same sound. (Turn to page #8. Point to the pictures of hat and bat.)

Everyone, do "hat" and "bat" rhyme? (signal)

Students: yes

Teacher: That's right. Hat and bat rhyme because they end in the same sound, "at." I'm going to show you some pictures. Turn to page #9. Point to "pail." This is a pail. What is this? (signal)

Students: pail

Teacher points to "buck": This is a buck. What is this? (signal)

Students: buck

Teacher points to "bud": This is a bud. What is this? (signal)

Students: bud

Teacher: Which word rhymes with mud? Pail (point to pail), buck (point to buck), or bud (point to bud)? (signal)

Students: bud

If students answer incorrectly, remind students that words rhyme when they end in the same sound. Repeat the words to the students. Then ask if the target word rhymes with each of the three choices.

Teacher: That's right! Mud and bud rhyme because they end in the same sound, "ud."

(Turn to page #10. Repeat same procedure for words: pants, hop, catch, and target word dance.)

(Turn to page #11. Repeat same procedure for words: nail, coat, rope, and target word pail.)

(Turn to page #12. Repeat same procedure for words: bead, bud, five, and target word dive.)

(Turn to page #13. Repeat same procedure for words: goat, five, bat, and target word coat.)

(Turn to page #14. Repeat same procedure for words: cat, wing, bud, and target word king.)

After you have completed this activity, give each student one Bingo Card and one page of picture cards. Make sure the Picture Card matches the one in your teacher's manual. Instruct students to cut and randomly past a picture card in each box on their Bingo Card.

Teacher: Now we are going to play a game. Before we begin, I am going to make sure you know what each picture on your Bingo Card is. Everyone, point to the goat. (Check to make sure each student finds the picture of the goat.) Everyone point to the bat. (Check to make sure each student finds the bat.)

Repeat for bud, wing, duck, mice, bush, nut, and fan. I am going to say a word. You will cross out the picture that rhymes with the word that I say. Let's do an example together. The word is buck. Remember, words rhyme when they end in the same sound. (Give students time to find the picture of the duck.) Everyone, what word did you cross out? (signal)

Students: duck

Teacher: Excellent, we are ready to start our game. Now we will keep our answers to ourselves. When you get three pictures in a row crossed out on your Bingo Card, you yell "Bingo!" Do you have any questions about how to play our game? (Note: Verbally praise students who reach bingo. Continue the game until all of the students have filled up their card.)

Teacher: (While students are participating in the game, circulate to evaluate individual performance.) Our next word is boat. Cross out the picture that rhymes with the word boat. (Pause). Word 3 is dice. Cross out the picture that rhymes with the word dice. (Pause) Word 4 is push. Cross out the picture that rhymes with the word push. (Pause) Word 5 is can. Cross out the picture that rhymes with the word can. (Pause) Word 6 is hut. Cross out the picture that rhymes with the word hut. (Pause) Word 7 is ring. Cross out the picture that rhymes with the word ring. (Pause) Word 8 is cat. (Pause) Word 9 is mud. Cross out the picture the rhymes with the word mud.

Script #3

Materials: Teacher's Manual
Memory Cards

Teacher: Today we are going to learn about beginning sounds in words. We are going to play more games. Some words have the same beginning sounds. Listen carefully to the first sound . . . bead (point to picture of bead) boat (point to picture of boat). They both have the same beginning sounds "b." Some words do not have the same beginning sounds. Listen carefully . . . sing (point to picture of sing) rope (point to picture of rope). They do not have the same beginning sound. Sing begins with the sound "s." Rope begins with the sound "r." Now it's your turn. I'll show you two pictures and you will tell me if the two words have the same beginning sound. Let's do the first one together. Everyone needs to answer on signal. This is how I signal (teacher taps table). Remember, only I signal.

Teacher points to page #17 with a picture of "man" and "mice."

Teacher points to man: This is a man. What is this? (signal)

Students: man

Repeat procedure until all students are answering on signal correctly.

Teacher: What is the beginning sound in man? (signal)

Students: "m"

Teacher points to mice: This is mice. What is this? (signal)

Students: mice

Teacher: What is the beginning sound in mice? (signal)

Students: "m"

Teacher: Do the words man and mice have the same beginning sound? (Emphasize beginning sounds) (signal)

Students: yes

Teacher: Correct. Man and mice begin with the same sound "m."

(Turn to page #18)

Teacher points to dog: This is a dog. What is this? (signal)

Students: dog

Teacher: What is the beginning sound in dog? (signal)

Students: "d"

Teacher points to tack: This is a tack. What is this? (signal)

Students: tack

Teacher: What is the beginning sound in tack? (signal)

Students: "t"

Teacher: Do the words dog and tack have the same beginning sound? (signal)

Students: no

Teacher: That's great! Dog and tack do not have the same beginning sound. Dog begins with the sound "d." Tack begins with the sound "t."

If students answer incorrectly, repeat the words again.

Enunciate the beginning sounds of each of the words. Then ask the students, Do these words begin with the same sound?

(Turn to page #19. Repeat the same procedure for the words: violin, vase.)

(Turn to page #20. Repeat the same procedure for the words: fan, phone.)

(Turn to page #21. Repeat the same procedure for the words: nose, boat.)

Teacher: Wow, you all did an awesome job learning about beginning sounds. We're going to play memory again. (Teacher places Memory cards face down on table in a square.) The first person to play picks up one of the cards on the table and says the word that picture shows. Then, he/she picks up another cards and says the word the picture show. If the two words have the same beginning sound, he/she gets to keep that pair of cards. If the two words do not have the same beginning sound, he/she must turn both of the cards back over. We are going to take turns moving around the table until everyone has a turn. When there are not any cards left on the table, the person with the most cards wins. (If someone wins quickly, play the game again.)

Script #4

Materials: Teacher's Manual

Student Bingo Cards (for each student)
Page of picture cards (for each student)
Glue
Crayons

Teacher: I want to see who can show me what they remember from the last time we were together. Remember, some words have the same beginning sound and some do not. (Turn to page #22. Point to picture of sock and rope.) Everyone, do "sock" and "rope" have the same beginning sound? (signal)

Students: no

Teacher: That's right. Sock and rope do not have the same beginning sound. Sock begins with the sound "s." Rope begins with the sound "r." I'm going to show you some pictures. (Turn to page #23. Point to "toad.")

This is a toad. What is this? (signal)

Students: toad

Teacher: What is the beginning sound of toad? (signal)

Students: "t"

Teacher points to "fork": This is a fork. What is this? (signal)

Students: fork

Teacher: What is the beginning sound of fork? (signal)

Students: "f"

Teacher points to "sock": This is a sock. What is this? (signal)

Students: sock

Teacher: What is the beginning sound of sock? (signal)

Students: "s"

Teacher: Which word has the same beginning sound as top? Toad (point to toad), fork (point to fork), or sock (point to sock)?

(Pause) . . . (signal)

Students: toad

If students answer incorrectly, repeat student choices. Then ask which word has the same beginning sound as the target word.

Teacher: That's right! Toad and top have the same beginning sound. They both begin with the sound "t."

(Turn to page #24. Repeat same procedure for words: nose, rose, dog, and target word nut.)

(Turn to page #25. Repeat same procedure for words: keys, toad, fan, and target word top.)

(Turn to page #26. Repeat same procedure for words: man, rope, bud, and target word bug.)

(Turn to page #27. Repeat same procedure for words: rose, fan, sock and target word ram.)

After you have completed this activity, give each student one Bingo Card and one page picture cards. Make sure the page of picture cards matches the one in your teacher's manual. Instruct students to cut and randomly paste a picture card in each box on their Bingo Card.

Teacher: Now we are going to play Bingo again. Before we begin I am going to make sure you know what each picture on your Bingo Card is. Everyone, point to the fan. (Check to make sure each student finds the picture of the fan.) Everyone, point to the wing. (Check to make sure each student finds the wing.) Repeat for lamb, goat, jog, sun, nose, bud, and dog.

I am going to say a word. You will cross out the picture that has the same beginning sound as the word I say. Let's do an example together.

The word is buck. Cross out the picture on your card that has the same beginning sound as the word buck.

(Give students time to find the picture of the bud.)

Everyone, what word did you cross out? (signal)

Students: bud

Teacher: Excellent. We are ready to start our game. Now we will keep our answers to ourselves. When you get three pictures in a row crossed out on your Bingo Card, you will yell "Bingo!" Raise your hand if you have any questions about how to play that game? (Note: Verbally praise students who reach bingo. Continue the game until all of the students have filled up their card.)

Teacher: (While students are participating in the game, circulate to evaluate individual performance.) Our next word is nut. Cross out the picture that has the same beginning sound as the word nut. (Pause) Word 3 is dice. Cross out the picture that has the same beginning sound as the word dice. (Pause) Word 4 is fox. Cross out the picture that has the same beginning sound as the word vase. (Pause) Word 5 is wave. Cross out the picture that has the same beginning sound as the word wave. (Pause) Word 6 is log. Cross out the picture that has the same beginning sound as the word log. (Pause) Word 7 is sock. Cross out the picture that has the same beginning sound as the word sock. (Pause) Word 8 is goose. Cross out the picture that has the same beginning sound as the word goose. (Pause) Word 9 is jam. Cross out the picture that has the same beginning sound as the word jam.

Script #5

Materials: Teacher's Manual
Memory Cards

Teacher: Today we are going to learn about the very last sounds in words. Some words have the same very last sound. Listen carefully to the very last sound. . . (Turn to page #28) dish (Point to picture of dish) bush (Point to picture of bush). They both have the same very last sound "sh." Some words do not have the same very last sound. Listen carefully . . . (Turn to page #29.) toad (Point to picture of toad) vase (Point to picture of vase). They do not have the same very last sound. The very last sound in toad is "d." The very last sound in vase is "s." Now it's your turn. I'll show you two pictures and you will tell me if the two words have the same very last sound. Let's do the first one together. Everyone needs to answer on signal. This is how I signal (teacher taps table). Remember only I signal.

(Turn to page #30)

Teacher points to dog: This is a dog. What is this?
(signal)

Students: dog

Repeat procedure until all students are answering on signal correctly.

Teacher: What is the very last sound in dog? (signal)

Students: "g"

Teacher points to bag: This is a bag. What is this?
(signal)

Students: bag

Teacher: What is the very last sound in bag? (signal)

Students: "g"

Teacher: Do the words dog and bag have the same very last sound? (Emphasize last sounds) (signal)

Students: yes

Teacher: Correct. Dog and bag have the same very last sound, "g."

(Turn to page #31)

Teacher points to duck: This is a duck. What is this?
(signal)

Students: duck

Teacher: What is the very last sound in duck? (signal)

Students: "k"

Teacher points to bead: This is a bead. What is this?
(signal)

Students: bead

Teacher: What is the very last sound in bead? (signal)

Students: "d"

Teacher: Do the words duck and bead have the same very last sound? (signal)

Students: no

Teacher: That's great! Duck and bead do not have the same very last sound. The very last sound in duck is "k." The very last sound in bead is "d."

If students answer incorrectly, repeat the words again.

Enunciate the last sounds of each of the words. Then as the students, Do these words have the same very last sound?

(Turn to page #32. Repeat the same procedure for the words: man and fan.)

(Turn to page #33. Repeat the same procedure for the words: hop and rope.)

(Turn to page #34. Repeat the same procedure for the words: nose and boat.)

Teacher: Wow, you all did an awesome job learning about very last sounds. Now we are going to play Memory again. (Teacher places memory cards face down on table in a square.) The first person to play picks up one of the cards on the table and says the word that picture shows. Then, he/she picks up another card and says the word the picture shows. If the two words have the same very last sound, he/she gets to keep that pair of cards. If the words do not have the same very last sound, he/she must turn both of the cards back over. We are going to take turns moving around the table until everyone has a turn. When there are not any cards left on the table, the person with the most cards wins. (If someone wins quickly, play the game again.)

Script #6

Materials: Teacher's Manual

Student Bingo Cards (for each student)

Page of picture cards (for each student)

Glue

Crayons

Teacher: I want to see who can show me what they remember from the last time we were together. Remember, some words have the same very last sounds and some do not. (Turn to page #35. Point to dish and fish.) Everyone, do "dish" and "fish" have the same very last sound? (signal)

Students: yes

Teacher: That's right. Dish and fish do have the same very last sound, "sh." I'm going to show you some pictures. (Turn to page #36. Point to "wave.") This is a wave. What is this? (signal)

Students: wave

Teacher: What is the very last sound in wave? (signal)

Students: "v"

Teacher points to "bush": This is a bush. What is this? (signal)

Students: "sh"

Teacher points to "bid": This is a bid. What is this? (signal)

Students: bud

Teacher: What is the very last sound in bud? (signal)

Students: "d"

Teacher: Which word has the same very last sound as dove? Wave (point to wave), bush (point to bush), or bud (point to bud)? (Pause) . . . (signal)

Students: wave

If students answer incorrectly, repeat student choices. Then ask which word has the same very last sound as the target word.

Teacher: That's right! Wave and dove have the same very last sound, "v."

(Turn to page #37). Repeat same procedure for words: dive, lamb, catch, and target word witch.)

(Turn to page #38. Repeat same procedure for words: fork, chain, face, and target word pen.)

(Turn to page #39. Repeat same procedure for words: dive, witch, boat, and target word wave.)

(Turn to page #40. Repeat same procedure for words: ram, bush, bun, and target word lamb.)

After you have completed this activity, give each student one Bingo Card and one page of picture cards. Make sure the picture card is the same one as in the teacher's manual.

Instruct students to cut and randomly paste a picture card in each box on their Bingo Card.

Teacher: Now we are going to play Bingo again. Before we begin, I am going to make sure you know what each picture on your Bingo Card is. Everyone, point to the bud. (Check to make sure each student finds the picture of the bud.) Everyone, point to dive. (Check to make sure each student finds dive.)

Repeat for fish, bug, witch, cat, lamb, hop, and duck.

I am going to say a word. You will cross out the picture that has the same very last sound as the word I say. Let's do an example together.

The word is bead. Cross out the picture on your card that has the same very last sound as the word bead.

(Give students time to find the picture of the bud.)

Everyone, what word did you cross out? (signal)

Students: bud

Teacher: Excellent. We ready to start our game. Now we will keep our answers to ourselves. When you get three pictures in a row crossed out on your Bingo Card, you yell "Bingo!" Raise your hand if you have any questions about how to play our game? (Note: Verbally praise students who reach bingo. Continue the game until all of the students have filled up their card.)

Teacher: (While students are participating in the game, circulate to evaluate individual performance.) Our next word is soap. Cross out the picture that has the same very last sound as the word soap. (Pause) Word 3 is hive. Cross out the picture that has the same very last sound as the word hive. (Pause) Word 4 is leg. Cross out the picture that has the same very last sound as the word leg. (Pause) Word 5 is bat. Cross out the picture that has the same very last sound as the word bat. (Pause) Word 6 is desk. Cross out the picture that has the same very last sound as the word desk. (Pause) Word 7 is comb. Cross out the picture that has the same very last sound as the word comb. (Pause) Word 8 is dish. Cross out the picture that has the same very last sound as the word dish. (Pause) Word 9 is pitch. Cross out the picture that has the same very last sound as the word pitch.

Script #7

Materials: Teacher's Manual
Memory Cards

Teacher: Today we are going to learn about the middle sounds in word. Some words can have the same middle sound. Do not listen to the beginning or the very last sound; listen to the middle sound. Listen carefully to the middle sound . . . (Turn to page #41.) pen (point to the picture of pen) jet (point to picture of jet). They both have the same middle sound "e." Some words do not have the same middle sound. Listen carefully . . . (Turn to page #42.) duck (point to picture of duck) keys (point to picture of keys.) They do not have the same middle sound. The middle sound in duck is "u." The middle sound in keys is "ee." Now it's your turn. I'll show you two pictures and you will tell me if the two words have the same middle sound. Let's do the first one together. Everyone needs to answer on signal. This is how I signal (teacher taps table.) Remember, only I signal.

(Turn to page #43.)

Teacher points to face. This is face. What is this?
(signal)

Students: face

Repeat procedure until all students are answering on signal correctly.

Teacher: What is the middle sound in face? (signal)

Students: "a"

(If the students have difficulty identifying the middle sound, have them identify the beginning and very last sound of each word. then have them identify the sound that is left, the middle sound.)

Teacher points to chain: This is a chain. What is this?
(signal)

Students: chain

Teacher: What is the middle sound in chain? (signal)

Students: "a"

Teacher: Do the words face and chain have the same middle sound? (Emphasize middle sounds) (signal)

Students: yes

Teacher: Correct. Face and chain have the same middle sound, "a."

(Turn to page #44)

Teacher points to leg: This is a leg. What is this?
(signal)

Students: leg

Teacher: What is the middle sound in leg? (signal)

Students: "a"

Teacher points to a cheek: This is a cheek. What is this? (signal)

Students: cheek

Teacher: What is the middle sound in cheek? (signal)

Students: "ee"

Teacher: Do the words leg and cheek have the same middle sound? (signal)

Students: no

Teacher: That's great! Leg and cheek do not have the same middle sound. The middle sound in leg is "a." The middle sound in cheek is "ee."

If students answer incorrectly, repeat the words again. Enunciate the middle sounds of each of the words. Then ask the students, Do these words have the same middle sound?

(Turn to page #45. Repeat the same procedure for the words: mice and dive.)

(Turn to page #46. Repeat the same procedure for the words: cat and hat.)

(Turn to page #47. Repeat the same procedure for the words: bun and face.)

Teacher: Wow, you all did an awesome job learning about middle sounds. Now we are going to play Memory again. (Teacher places Memory cards face down on table in a square.) The first person to play picks up one of the cards on the table and says the word that picture shows. Then he/she picks up another card and says the word that picture shows. If the two words have the same middle sound, he/she gets to keep that pair of cards. If the words do not have the same middle sound, he/she must turn both of the cards back over. We are going to take turns moving around the table until everyone has a turn. When there are not any cards left on the table, the person with the most cards wins. (If someone wins quickly, play the game again.)

Script #8

Materials: Teacher's Manual

Student Bingo Cards (for each student)
Page of picture cards (for each student)
Glue
Crayons

Teacher: I want to see who can show me what they remember from the last time we were together. Remember, some words have the same middle sounds and some do not. (Turn to page #48. Point to pictures of dish and fish.) Everyone, do "dish" and "fish" have the same middle sound? (signal)

Students: yes

Teacher: That's right. Dish and fish have the same middle sound, "I." I'm going to show you some pictures. (Turn to page #49. Point to "hop.") This is hop. What is this? (signal)

Students: hop

Teacher: What is the middle sound in hop? (signal)

Students: "o"

Teacher points to "nose": This is a nose. What is this? (signal)

Students: nose

Teacher: What is the middle sound in nose? (signal)

Students: "o"

Teacher points to "fish": This is a fish. What is this? (signal)

Students: fish

Teacher: What is the middle sound in fish? (signal)

Students: "I"

Teacher: Which word has the same middle sound as sew?

Hop (point to hop), nose (point to nose), or fish (point to fish)?

(Pause) . . . (signal)

Students: nose

If students answer incorrectly, repeat student choices. Then ask which word has the same middle sound as the target word.

Teacher: That's right! Nose and sew have the same middle sound, "o."

(turn to page #50. Repeat same procedure for words: face, jet, moon, and target word moose).

(Turn to page #51. Repeat same procedure for words: catch, moon, keys, and target word cheek.)

(Turn to page #52. Repeat same procedure for words: face, goose, fish, and target word chain.)

(Turn to page #53. Repeat same procedure for words: pen, hop, mice, and target word ten.)

After you have completed this activity, give each student one Bingo Card and one page of picture cards. Make sure the

picture card matches the one in your teacher's manual. Instruct students to cut and randomly past a picture card in each box on their Bingo Card.

Teacher: Now we are going to play Bingo again. Before we begin, I am going to make sure you know what each picture on your Bingo Card is. Everyone, point to the face. (Check to make sure each student finds the picture of the face.) Everyone, point to the bun. (Check to make sure each student finds bun.)

Repeat for mice, bat, keys, moon, pen, fish, and sock. I am going to say a word. You will cross out the picture that has the same middle sound as the word I say. Let's do an example together. The word is hive. Cross out the picture on your card that has the same middle sound as the word hive. (Give students time to find the picture of the mice.) Everyone, what word did you cross out? (signal)

Students: mice

Teacher: Excellent. We are ready to start our game. Now we will keep our answers to ourselves. When you get three pictures in a row crossed out on your Bingo Card, you yell "Bingo!" Raise your hand if you have any questions about how to play our game. (Note: Verbally praise students who reach bingo. Continue the game until all of the students have filled up their card.)

Teacher: (While students are participating in the game, circulate to evaluate individual performance.) Our next word is fun. Cross out the picture that has the same middle sound as the word fun. (Pause) Word 3 is hen. Cross out the picture that has the same middle sound as the word hen. (Pause) Word 4 is cage. Cross out the picture that has the same middle sound as the word cage. (Pause) Word 5 is tap. Cross out the picture that has the same middle sound as the word tap. (Pause) Word 6 is cheek. Cross out the picture that has the same middle sound as the word cheek. (Pause) Word 7 is goose. Cross out the picture that has the same middle sound as the word goose. (Pause) Word 8 is sick. Cross out the picture that has the same middle sound as the word sick. (Pause) Word 9 is lock. Cross out the picture that has the same middle sound as the word lock.

Script #9

Materials: Teacher's Manual
 Student Bingo Cards (for each student)
 Page of picture cards (for each student)
 Scissors
 Glue
 Crayons

Teacher: Today we are going to learn about blending sounds together in words. I think you are going to like the activity because we will play games. Many sounds are blended together to make a word. I'll show you how to blend sounds together to make a word.
 (Turn to page #1) Listen . . . paint (point to picture of paint). When I put these sounds together, p-aint, they make the word paint. Let's try one together. Don't forget to answer on signal. Remember this is how I signal (signal). Only I signal.

(Turn to page #2)

Teacher points to picture of leg: This is a leg. What is this? (signal)

Students: leg

Teacher: When you put these sounds together, l-eg,, do they make the word leg? (signal)

Students: yes

If students answer incorrectly, repeat the word sound by sound. Then ask which word the sounds make when put together.

Teacher: Excellent. When you put the sounds l-eg together, they make the word leg.

(Turn to page #3)

Teacher points to picture of 2: This is two. What is this? (signal)

Students: two

Teacher: When you put these sounds together h-ook, do they make the word two? (signal)

Students: no.

Teacher: Very good. When you put the sounds h-ook together, they do not make the word two. The sounds h-ook make the word hook. The word two is made up of the sounds t-oo.

(Turn to page #4. Repeat same procedure for the word bug and sounds b-ug.)

(Turn to page #5. Repeat same procedure for the words moo and sounds m-oo.)

(Turn to page #6. Repeat same procedure for the word tire and sounds t-ire.)

(Turn to page #7. Repeat same procedure for the word bone and sound b-one.)
 (Turn to page #8. Repeat same procedure for word shirt and sound g-um.)
 (Turn to page #9. Repeat same procedure for word beak and sound b-eak.)
 (Turn to page #10. Repeat same procedure for word knife and sounds n-ife.)

After you have completed this activity, give each student one Bingo card and one page of Picture Cards. Make sure the page of picture cards matches the one in your teacher's manual. Instruct students to cut and randomly paste a Picture Card in each box on their Bingo Card.

Teacher: Now we are going to play Bingo again. Before we begin, I am going to make sure you know what each picture on your Bingo Card is. Everyone, point to paint. (Check to make sure each student finds the picture of paint.) Everyone, point to the leg. (Check to make sure each student finds the picture of leg.) Repeat for bug, two, moo, tire, bone, fan, and knife. I am going to say the sound of word. You will cross out the picture of the word those sounds make when put together. Let's do an example together. The sounds are b-one. When you put the sounds b-one together, they make a word. Cross out the picture of that word. (Give students time to find the picture of the bone.)

Everyone, what word did you cross out? (signal)

Students: bone

Teacher: Excellent. The sounds b-one make the word bone. We are ready to start our game. Now we will keep our answers to ourselves. When you get three pictures in a row crossed out on your Bingo Card, you call out "Bingo." Raise your hand if you have any questions about how to play our game. (Note: Verbally praise students who reach Bingo. Continue the game until all of the students have filled up their card.)

Teacher: (While students are participating in the game, circulate to evaluate individual performance.) Our next sounds are n-ife. When you put the sounds n-ife together, they make a word. Cross out the picture of that word. (Pause) The next sounds are b-ug. When you put the sounds b-ug together, they make a word. Cross out the picture of that word. (Pause)

Repeat procedure for t-oo, t-ire, f-an, l-eg, p-aint, and m-oo.

Script #10

Materials: Teacher's Manual
 Board Game
 Dice
 Game Pieces (provided) Dollar Store Erasers

Teacher: Today we are going to learn some more about blending sounds together in words. Many sounds are blended together to make a word. I'll show you how to blend sounds together to make a word. (Turn to page #11.) Listen . . . knife (point to picture of knife). When I put these sounds together n-ife, they make the word knife. Let's do some examples together. Don't forget to answer on signal. This is how I signal (signal). Only I signal.

(Turn to page #12)

Teacher: I'm going to show you some pictures. (Teacher points to tape.) This tape. What is this? (signal)

Students: tape.

Teacher points to ball: This is ball. What is this? (signal)

Students: ball

Teacher points to knife: This is a knife. What is this? (signal)

Students: knife

Teacher: When I put these sound together b-all, do they make the word tape (point to tape), ball (point to ball), or knife (point to knife)? (signal)

Students: ball

If students answer incorrectly, repeat choices. Then ask which word the sounds make when put together.

Teacher: That's right! When I put the sounds b-all together, they make the word ball.

(Turn to page #13. Repeat same procedure for the words nail, shirt, mice, and target sound n-ail.)

(Turn to page #14. Repeat same procedure for the words tire, book, bow, and target sounds t-ire.)

(Turn to page #15. Repeat same procedure for the words lake, lid, hook, and target sounds l-id.)

(Turn to page #16. Repeat same procedure for the words seal, fire, tie, and target sounds t-ie.)

After you have completed this activity, lay out the game board and dice. Make sure each student has one game piece.

Teacher: Now we are going to play the Picture Game. Let me explain the rules of our game. The first person rolls the dice. He or she moves forward on the game board the number of spaces shown on the dice.

For example, if I roll a 6, I would move forward 6 spaces. Then he/she must say the word the picture they land on shows. Next, he/she will break that word up into two parts. For example, if I land on the picture of the cat, I would say "cat" and then I would say "c-at." If he/she breaks the words up into the correct sounds, he/she remains on the space. If he/she does not break the word up into the correct sounds, he/she must go back the number of spaces they rolled. The person sitting to the right goes next. I'm going to make sure you know what each picture on the game board is. (Point to the picture as you name it.) Picture 1 is bug. Picture 2 is shirt. Picture 3 is paint. Picture 4 is leg. Picture 5 is hand. Picture 6 is moo. Picture 7 is neck. Picture 8 is trash. Picture 9 is cake. Picture 10 is fire. Picture 11 is book. Picture 12 is mice. Picture 13 is two. Picture 14 is hog. Picture 15 is tire. Picture 16 is bone. Picture 17 is knife. Picture 18 is fan. Picture 19 is dance. Picture 20 is key. Picture 21 is crab. Picture 22 is snail. Picture 23 is lake. Picture 24 is chair. (Pick a student who has participated well in today's lesson to start the game as a reinforcement. If the students cooperate during they game, they may keep their game pieces.) Continue to play the game until time has run out for today's lesson.

Script #10

Materials: Teacher's Manual
Tic Tac Toe picture cards (9)
Marker

Teacher: I want to see who can show me what they remember from the last time we were together. Remember many sounds are blended together to make a word. Today we are going to change our word game. I'll say a word. Then you will break the word into two parts. Say each sound in the order that you hear it. (Point to page #17.) For example, if I say the word ball, you would break the word into two parts, b-all. Let's try one together. Don't forget to answer on signal. Remember this is how I signal. (signal) Only I signal.

(Turn to page #18)

Teacher points to picture of bow. This is a bow. What is this? (signal)

Students: bow

Teacher: Now you break bow into two parts. (signal)

Students: b-ow

Teacher: Excellent! When you break bow into two parts, you say b-ow.

If students answer correctly, repeat the word, break the word into two parts, and then ask the students to break the word into two parts.

(Turn to page #19. Repeat same procedure for the word car and sounds c-ar.)

(Turn to page #20. Repeat same procedure for the word ape and sounds a-pe.)

(Turn to page #21. Repeat same procedure for the word nail and sounds n-ail.)

(Turn to page #22. Repeat same procedure for the word but and sounds b-ut.)

(Turn to page #23. Repeat same procedure for the word shirt and sounds sh-irt.)

Turn back to page #18. Call on individual students to break each of the words (pages 18-23) into two parts. Make sure each student has at least one turn.

After you have completed this activity, lay the 9 Tic Tac Toe cards face down on the table in a square. Divide students into two groups. Get marker.

Teacher: Now we are going to play Tic Tac Toe. This group is going to be X (point to one of the groups) and this group is going to be O (point to the other group).

Group X will go first. The group will pick up one of the cards on the table. Then they will say the word that picture shows. Next, the group will break the word into two parts. For example, if I pick up the card with the picture of a cat on it, I would say "cat" and then I would say "c-at." If the group breaks the word up into the correct parts, they get an X marked on that card. If the group does not break the word up into the correct parts, the card is flipped back over and the group does not get the X. I will put the X's and O's on the cards with my marker. The first group to get 3 X's or O's in a row is the winner. Continue to play the game until time has run out for today's lesson.

Script #12

Materials: Teacher's Manual
Board Game
Dice
Game Pieces (provided) Dollar Store Erasers

Teacher: Today we are going to learn some more about blending sounds together in words. Many sounds are blended together to make a word. I'll show you how to blend sounds together to make a word. (Turn to page #24.) Listen . . . knife (point to picture of knife). When I put these sounds together n-ife, they make the word knife. Let's do some examples together. Don't forget to answer on signal. This is how I signal (signal). Only I signal.

(turn to page #25)

Teacher: I'm going to show you some pictures. (Teacher points to bone.) This is a bone. What is this? (signal)

Students: bone

Teacher points to car: This is a car. What is this? (signal)

Students: car

Teacher point to seal: This is a seal. What is this? (signal)

Students: seal

Teacher: When I put these sounds together s-eal, what word do they make? (signal)

Students: seal

If students answer incorrectly, repeat choices. Then ask which word the sounds make when put together.

Teacher: That's right! When I put the sounds s-eal together, they make the word seal.

(Turn to page #26. Repeat same procedure for the words paint, mice, bell, and target sounds m-ice).

(Turn to page #27. Repeat same procedure for the words car, moq, shirt, and target sounds sh-irt.)

(Turn to page #28. Repeat same procedure for the words bell, moq, seal, and target sounds b-ell.)

(Turn to page #29. Repeat same procedure for the words seal, moq, tie, and target sounds m-oq.)

After you have completed this activity, lay out the game board and dice. Make sure each student has one game piece.

Teacher: Now we are going to play the Picture Game. Let me explain the rules of our game. The first person rolls the dice. He or she moves forward on the game board the number of spaces shown on the dice. For example, if I roll a 6, I would move forward 6

spaces. Then he/she must say the word the picture they land on shows. Next, he/she will break that word up into two parts. For example, if I land on the picture of the cat, I would say "cat" and then I would say "c-at." If he/she breaks the words up into the correct sounds, he/she remains on the space. If he/she does not break the word up into the correct sounds, he/she must go back the number of spaces they rolled. The person sitting to the right goes next. (Pick a student who has participated well in today's lesson to start the game as a reinforcement. If the students cooperate during the game, they may keep their game pieces.)

Script #13

Materials: Teacher's Manual
 Bingo Cards (for each student)
 Bingo Picture Cards (for each student)
 Scissors
 Crayons
 Glue
 Picture of Robbie the Robot

Teacher: Today we are going to learn about blending sounds together in words. I think you are going to like this activity because we will play some more games. Many sounds are blended together to make a word. My friend Robbie the Robot (hold up picture of Robbie the Robot) taught me how to talk like a robot. (Turn to page #30. Speak in a robot voice.) Listen . . . h-og (point to picture of hog). It is hard to understand what I am saying because I talk so slowly when I talk like a robot. I need you to help me by blending the sounds I say together to make words. When I put the sounds h-o-g together, they make the word hog. Let's try one together. Don't forget to answer on signal. Remember this is how I signal (signal). Only I signal.

Say all of the following sounds in a Robbie the Robot voice.

(Turn to page #31)

Teacher points to picture of book: This is a book. What is this? (signal)

Students: book

Teacher: When you put these sounds together b-oo-k, do they make the word book? (signal)

Students: yes

If students answer incorrectly, repeat the segmented word again and say each sound faster, i.e., blend the word more for the students.

Teacher: That's right! When you help Robbie the Robot put the sounds b-oo-k together, they make the word book.

(Turn to page #32)

Teacher points to picture of tire: This is a tire. What is this? (signal)

Students: tire

Teacher: When you put these sounds together p-a-le, do they make the word tire? (signal)

Students: no

Teacher: Excellent! When you help Robbie the Robot put the sounds p-a-le together, they do not make the word tire. Raise your hand if you can tell me what word the sounds p-a-le make.

(Turn to page #33. Repeat same procedure for the word fire and sounds f-i-re.)
 (Turn to page #34. Repeat same procedure for the word hog and sounds p-i-pe.)
 (Turn to page #35. Repeat same procedure for the word wash and sounds w-a-sh.)
 (Turn to page #36. Repeat same procedure for the word bone and sounds t-a-le.)
 (Turn to page #37. Repeat same procedure for the word mice and sounds m-i-ce.)
 (Turn to page #38. Repeat same procedure for the word mice and sounds b-i-b.)
 (Turn to page #39. Repeat same procedure for the word hog and sounds w-a-sh.)

After you have completed this activity, give each student one Bingo card and one page of Picture Cards. Make sure the page of picture cards matches the one in your teacher's manual. Instruct students to cut and randomly paste a Picture Card in each box on their Bingo Card.

Teacher: Now we are going to play Bingo again. Before we begin, I am going to make sure you know what each picture on your Bingo Card is. Everyone point to the book. (Check to make sure each student finds the picture of the book.) Everyone point to two. (Check to make sure each student finds the picture of the two.) Repeat for mice, knife, tire, fan, bone, hog, and fire.

I am going to talk like Robbie the Robot. I will say the sounds of a word. You will cross out the picture of the word those sounds make when put together. Let's do an example together. The sounds are m-i-ce. When you help Robbie the Robot put the sounds m-i-ce together, they make a word. Cross out the picture of that word. (Give students time to find the picture of the mice.) Everyone, what word did you cross out? (signal)

Students: mice

Teacher: Excellent! The sounds m-i-ce make the word mice. We are ready to start our game. Now we will keep our answers to ourselves. When you get three pictures in a row crossed out on your Bingo Card, you call out "Bingo." Raise your hand if you have any questions about how to play our game. (Note: Verbally praise students who reach Bingo. Continue the game until all of the students have filled up their card.)

Teacher: (While students are participating in the game, circulate to evaluate individual performance. Our next sounds are h-o-g. When you help Robbie the Robot put the sounds h-o-g together, they make a word. Cross out the picture of that word. (Pause) The next sounds are t-i-re. When you help Robbie the Robot put

the sounds t-i-re together, they make a word. Cross out the picture of that word. (Pause)

Repeat procedure for the sounds t-oo, f-a-n, n-i-fe, f-i-re, b-oo-k, and b-o-ne.

Script #14

Materials: Teacher's Manual

Board Game

Dice

Game Pieces (provided) Dollar Store Erasers

Picture of Robbie the Robot

Teacher: Today we are going to learn some more about blending sounds together in words. Many sounds are blended together to make a word. I'll show you how to blend sounds together to make a word. (Turn to page #40.) Listen . . . mice (point to picture of mice). When I put these sounds together m-i-ce, they make the word mice. Let's do some examples together. Don't forget to answer on signal. This is how I signal (signal). Only I signal.

(Turn to page #41)

Teacher: I'm going to talk like my friend Robbie the Robot again (hold up picture of Robbie the Robot). It's hard to understand what I am saying because I talk so slowly when I talk like a robot. I need you to help me by blending the sounds I say together to make words. I'm going to show you some pictures. (Teacher points to tail.) This is a tail. What is this?

(signal)

Students: tail

Teacher points to fire: This is a fire. What is this?

(signal)

Students: fire

Teacher points to a dime: This is a dime. What is this?

(signal)

Students: dime

Teacher: When I put these sounds together f-i-re, do they make the word tail (point to tail), fire (point to fire), or dime (point to dime)? (signal)

Students: fire

If the students answer incorrectly, repeat choices. Then ask which word the sounds make when put together. If problems persist, blend the sounds together faster.

Teacher: That's right! When you help Robbie the Robot put the sounds f-i-re together, they make the word fire.

(Turn to page #42. Repeat same procedure for the words tape, hog, lake, and target sound l-a-ke.)

(Turn to page #43. Repeat same procedure for the words neck, lake, dog, and target sounds n-e-ck.)

(Turn to page #44. Repeat same procedure for the words hog, fire, dog, and target sounds d-o-g.)

(Turn to page #45. Repeat same procedure for the words bone, lid, pail, and target sounds b-o-ne.)

After you have completed this activity, lay out the game board and dice. Make sure each student has one game piece.

Teacher: Now we are going to play the Picture Game. Let me explain the rules of our game. The first person rolls the dice. He or she moves forward on the game board the number of spaces shown on the dice. For example, if I roll a 6, I would move forward 6 spaces. Then he/she must say the word the picture they land on shows. Next, he/she will say the word sound by sound. For example, if I land on the picture of the bone, I would say "bone" and then I would say "b-o-ne." If he/she correctly says the word sound by sound, he/she remains on the space. If he/she does not correctly say the word sound by sound, he/she must go back the number of spaces they rolled. The person sitting to the right goes next. (Pick a student who has participated well in today's lesson to start the game as a reinforcement. If the students cooperate during the game, they make keep their game pieces.) Continue to play the game until time has run out for today's lesson.

Script #15

Materials: Teacher's Manual
Tic Tac Toe picture cards (9)
Marker

Teacher: I want to see who can show me what they remember from the last time we were together. Remember many sounds are blended together to make a word. Today we are going to change our word game. I'll say a word. Then you will talk like Robbie the Robot and say the word sound by sound. Say each sound in the order that you hear it. (Point to page #46.) For example, if I say the word dog, you would say dog sound by sound, d-o-g. Remember to talk like Robbie the Robot. Let's try one together. Don't forget to answer on signal. Remember this is how I signal (signal). Only I signal.

(Turn to page #47)

Teacher points to picture of cup: This is a cup. What is this? (signal)

Students: cup

Teacher: Now talk like Robbie the Robot and say the word cup sound by sound. (signal)

Students: c-u-p

If students answer incorrectly, repeat the word, say the word sound by sound, and then ask the students to say the word sound by sound.

Teacher: Excellent! When you say the word cup sound by sound, you say c-u-p.

(Turn to page #48. Repeat same procedure for word book and sounds b-oo-k.)

(Turn to page #49. Repeat same procedure for word tail and sounds t-ai-l.)

(Turn to page #50. Repeat same procedure for word tire and sounds t-i-re.)

(Turn to page #51. Repeat same procedure for word mice and sounds m-i-ce.)

(Turn to page #52. Repeat same procedure for word shirt and sounds sh-ir-t.)

Turn back to page #47. Call on individual students to say each word sound by sound (pages 47-52). Make sure each student has at least one turn.

After you have completed this activity, lay the 9 Tic Tac Toe cards face down on the table in a square. Divide students into two groups. Get a marker.

Teacher: Now we are going to play Tic Tac Toe. This group is going to be X (point to one of the groups) and this group is going to be O (point to the other group). Group X will go first. The group will pick up one of the cards on the table. Then they will say the word that picture shows. Next, the group will say the word sound by sound. For example, if I pick up the card with a picture of a cat on it, I would say "cat" and then I would say "c-a-t." If the group says the word sound by sound, they get an X marked on that card. If the group does not say the word sound by sound, the card is flipped back over and the group does not get the X. I will put the X's and O's on the card with my marker. The first group to get 3 X's or O's in a row is the winner.

Continue to play the game until time has run out for today's lesson.

Script #16

Materials: Teacher's Manual

Board Game

Dice

Game Pieces (provided) Dollar Store Erasers

Picture of Robbie the Robot

Teacher: Today we are going to learn some more about blending sounds together in words. Many sounds are blended together to make a word. (Turn to page #53.) Listen . . . knife (point to picture of knife). When I put these sounds together n-i-fe, they make the word knife. Let's do some examples together. Don't forget to answer on signal. This is how I signal (signal). Only I signal.

(Turn to page #54)

Teacher: I'm going to talk like my friend Robbie the Robot again. (Hold up picture of Robbie the Robot.) It's hard to understand what I am saying because I talk so slowly when I talk like a robot. I need you to help me by blending the sounds I say together to make words. I am going to show you some pictures. (Teacher points to fire.) This is a fire. What is this?

(signal)

Students: fire

Teacher points to lake: This is a lake. What is this?

(signal)

Students: lake

Teacher points to neck: This is a neck. What is this?

(signal)

Students: neck

Teacher: When I put these sounds together n-e-ck, what word do they make? (signal)

Students: neck

If students answer incorrectly, repeat choices. Then ask which word the sounds make when put together. If problems persist, blend the sounds together faster.

Teacher: That's right! When you help Robbie the Robot put the sounds n-e-ck together, they make the word neck.

(Turn to page #55. Repeat same procedure for the words lid, dime, fire, and target sounds f-i-re.)

(Turn to page #56. Repeat same procedure for the words cake, lid, bell, and target sounds l-i-d.)

(Turn to page #57. Repeat same procedure for the words chair, bell, mice, and target sounds ch-ai-r.)

(Turn to page #58. Repeat same procedure for the words seal, cup, knife, and target sounds s-e-a-l.)

After you have completed this activity, lay out the game board and dice. Make sure each student has one game piece.

Teacher: Now we are going to play the Picture Game. Let me explain the rules of our game. The first person rolls the dice. He or she moves forward on the game board the number of spaces shown on the dice. For example, if I roll a 6, I would move forward 6 spaces. Then he/she must say the word the picture they land on shows. Next, he/she will say the word sound by sound. For example, if I land on the picture of the bone, I would say "bone" and then I would say "b-o-ne." If he/she correctly says the word sound by sound, he/she remains on the space. If he/she does not correctly say the word sound by sound, he/she must go back the number of spaces they rolled. The person sitting to the right goes next. (Pick a student who has participated well in today's lesson to start the game as a reinforcement. If the students cooperate during the game, they may keep their game pieces.)

Script #17

Materials: Teacher's Manual
 Bingo Cards (for each student)
 Bingo Number Cards (for each student)
 Scissors
 Crayons
 Glue
 Picture of Robbie the Robot

Teacher: Today we are going to learn about counting sounds in words. I think you are going to like the activity because we will play games. Let's remember how Robbie the Robot talked very slowly. You had to help him put sounds together to make words. Today we are going to talk like Robbie the Robot again and we will learn how to count the number of sounds in words. (Turn to page #59) Listen . . . two (point to picture of two). The word two is made from two sounds, t-oo. Watch how I use my fingers to help me count the number of sounds. T . . . (Teacher holds up one finger) oo . . . (Teacher holds up two fingers). Let's try one together. Don't forget to answer on signal. Remember this is how I signal (signal). Only I signal.

(Turn to page #60)

Teacher points to picture of dog: This is a dog. What is this? (signal)

Students: dog

Teacher: Use your fingers to count the number of sounds in the word dog. D . . . (hold up one finger) o . . . (hold up two fingers) g . . . (hold up three fingers).

Teacher: Does the word dog have three sounds? (signal)
 Students: yes

If students answer incorrectly, repeat the sounds in each word and hold up fingers accordingly. Then ask how many sounds the word has.

Teacher: Excellent! The word dog has three sounds, d-o-g.

(Turn to page #61)

Teacher points to picture of cross: This is a cross. What is this? (signal)

Students: cross

Teacher: Use your fingers to count the number of sounds in the word cross. C . . . (hold up one finger) r . . . (hold up two fingers) o . . . (hold up three fingers) ss . . . (hold up four fingers)

Teacher: Does the word cross have two sounds? (signal)
 Students: no

Teacher: Very good. The word cross does not have two sounds. Raise your hand if you know how many sounds

the word cross has. Call on students who raise their hand. If students answer incorrectly, repeat the sounds in each word and hold up fingers accordingly. Then ask how many sounds the word has.

(Turn to page #62. Repeat the same procedure for the word safe, s-a-fe, and 3 sounds.)

(Turn to page #63. Repeat the same procedure for the word smile, s-m-i-le, and 2 sounds.)

(Turn to page #64. Repeat the same procedure for the word bone, b-o-ne, and 2 sounds.)

(Turn to page #65. Repeat the same procedure for the word ski, s-k-i, and 3 sounds.)

(Turn to page #66. Repeat the same procedure for the word leg, l-e-g, and 3 sounds.)

(Turn to page #67. Repeat the same procedure for the word hand, h-a-n-d, and 4 sounds.)

(Turn to page #68. Repeat the same procedure for the word bear, b-e-a-r, and 2 sounds.)

After you have completed this activity, give each student one Bingo card and one page of Number Cards. Make sure the page of number cards matches the one in your teacher's manual. Instruct students to cut and randomly past a Number Card in each box on their Bingo Card.

Teacher: Now we are going to play Bingo again. I am going to say a word. you will cross out the number of sounds that word has on your Bingo Card. Let's do an example together. The word is bone, b-o-ne. (Do not hold up your fingers to show the number of sounds.) Cross out the number of sounds that bone has. Only cross out one number on your Bingo Card even if the same number is on your card more than one time. (Give students time to find the number three.) Everyone, what number did you cross out? (signal)

Students: three

Teacher: Excellent! The word bone has three sounds in it, b-o-ne. We are ready to start our game. Now we will keep our answers to ourselves. When you get three numbers in a row crossed out on your Bingo Card, you call out "Bingo." Raise your hand if you have any questions about how to play our game. (Note: Verbally praise students who reach Bingo. Continue the game until all of the students have filled up their card.)

Teacher: (While students are participating in the game, circulate to evaluate individual performance. Our next word is pie, p-ie. Cross out the number of sounds that pie has. (Pause) The next word is bus, b-u-s. Cross out the number of sounds that bus has. (Pause) Repeat procedure for snail, s-n-a-i-l; too, t-oo; tire, t-i-re; gum, g-u-m; paint, p-a-i-n-t; and moo, m-oo.

Script #18

Materials: Teacher's Manual

Board Game

Dice

Game Pieces (provided) Dollar Store Erasers

Teacher: Today we are going to learn some more about counting sounds in words. Words are made from many sounds. (Turn to page #69.) Listen . . . knife (point to picture of knife). The word knife is made from 3 sounds, n-i-fe. Let's clap our hands to count the number of sounds in the word knife. N . . . (clap) i . . . (clap) fe . . . (clap). Let's do some examples together. Don't forget to answer on signal. This is how I signal (signal). Only I signal.

(Turn to page #70)

Teacher: I'm going to show you some numbers and pictures. (Teacher points to picture of cake.) This is cake. What is this? (signal)

Students: cake

Teacher claps as she says the sounds: C . . . (clap) a . . . (clap) ke . . . (clap)

Teacher: How many sounds are there in the word cake. 2 (point to 2), 3 (point to 3), or 4 (point to 4)? (signal)

Students: 3

If students answer incorrectly, repeat the sounds by clapping. The ask how many sounds the word has.

Teacher: That's right! The word cake has 3 sounds, c-a-ke.

(Turn to page #71. Repeat same procedure for the word how, b-ow, 2 sounds.)

(Turn to page #72. Repeat same procedure for the word safe, s-a-fe, 3 sounds.)

(Turn to page #73. Repeat same procedure for the word key, k-ey, 2 sounds.)

(Turn to page #74. Repeat same procedure for the word dance, d-a-n-ce, 4 sounds.)

Teacher: Now we are going to play the Picture Game. Let me explain the rules of our game. The first person rolls the dice. He or she moves forward on the game board the number of spaces shown on the dice. For example, if I roll a 6, I would move forward 6 spaces. Then he/she must say the word the picture they land on shows. Next, he/she will say the word sound by sound and give the number of sounds each word has. For example, if I land on the picture of the cat, I would say "cat," "c-a-t," and "3 sounds." If he/she says the word sound by sound correctly and

gives the right number of sounds, he/she remains on the space. If he/she does not say the word sound by sound correctly and does not give the right number of sounds, he/she must go back the number of spaces they rolled. The person sitting to the right goes next. (Pick a student who has participated well in today's lesson to start the game as a reinforcement. If the students cooperate during the game, they may keep their game pieces.) Continue to play the game until time has run out for today's lesson.

Script #19

Materials: Teacher's Manual
Tic Tac Toe Picture Cards (9)
Marker

Teacher: Today we are going to learn more about counting sounds in words. I think you are going to like the activity because we will play games. Words are made from many sounds. (Turn to page #75) Listen . . . beak (point to picture of beak). The word beak is made from 3 sounds b-ea-k. Watch how I use my fingers to help me count the number of sounds. B . . . (teacher holds up one finger) ea . . . (teacher holds up two fingers) k . . . (Teacher holds up three fingers.) Let's try one together. Don't forget to answer on signal. Remember this is how I signal (signal). Only I signal.

(Turn to page #76)

Note: Teacher does not aid students by holding up fingers. Teacher points to picture of snake: This is a snake.

What is this? (signal)

Students: snake

Teacher: Use your fingers to count the number of sounds in the word snake. S-n-a-ke.

Teacher: Does the word snake have four sounds? (signal)

Students: yes

If students answer incorrectly, repeat the sounds in each word and hold up fingers accordingly. Then ask how many sounds the word has.

Teacher: Excellent! The word snake has four sounds, s-n-a-ke.

(Turn to page #77)

Teacher points to picture of trash: This is trash. What is this? (signal)

Students: trash

Teacher: Use your fingers to count the number of sounds in the word trash. T-r-a-sh. (signal)

Teacher: Does the word trash have three sounds?

Students: no

Teacher: Very good. The word trash does not have three sounds. Raise your hand if you know how many sounds the word trash has. Call on students who raise their hand. If students answer incorrectly, repeat the sounds in each word and hold up fingers accordingly. Then ask how many sounds the word has.

(Turn to page #78. Repeat same procedure for the word bed, b-e-d, and 3 sounds.)

(Turn to page #79. Repeat same procedure for the word pie, p-i-e, and 3 sounds.)

(Turn to page #80. Repeat same procedure for the word frog, f-r-o-g, and 2 sounds.)

(Turn to page #81. Repeat same procedure for the word ski, s-k-i, and 3 sounds.)

(Turn to page #82. Repeat same procedure for the word smile, s-m-i-le, and 2 sounds.)

(Turn to page #83. Repeat same procedure for the word hand, h-a-n-d, and 4 sounds.)

(Turn to page #84. Repeat same procedure for the word bear, b-e-a-r, and 2 sounds.)

Turn back to page #76. Call on individual students to say each of the words sound by sound and tell you the number of sounds each word has (pages 76-84). Make sure each student has at least one turn.

After you have completed this activity, lay the 9 Tic Tac Toe cards face down on the table in a square. Divide students into two groups. Get a marker.

Teacher: Now we are going to play Tic Tac Toe. This group is going to be X (point to one of the groups) and this group is going to be O (point to the other group). Group X will go first. The group will pick up one of the cards on the table. Then they will say the word that picture shows. Next, the group will say the word sound by sound and tell me the number of sounds the word has. For example, if I pick up the card with a picture of a cat on it, I would say "cat," "c-a-t," and "3 sounds." If the group says the word sound by sound correctly and gives the right number of sounds, they get an X marked on that card. If the group does not say the word sound by sound correctly and does not give the right number of sounds, the card is flipped back over and the group does not get the X. I will put the X's and O's on the cards with my marker. The first group to get 3 X's or O's in a row is the winner. Continue to play the game until time has run out for today's lesson.

Script #20

Materials: Teacher's Manual

Board Game

Dice

Game Pieces (provided) Dollar Store Erasers

Teacher: Today we are going to learn some more about counting sounds in words. Words are made up from many sounds. (Turn to page #85.) Listen . . . knife (point to picture of knife). The word knife is made from 3 sounds, n-i-fe. Let's do some examples together. Don't forget to answer on signal. This is how I signal (signal). Only I signal.

(Turn to page #86)

Teacher: I'm going to show you some numbers and pictures. (Teacher points to picture of trash.) This is trash. What is this? (signal)

Students: trash

Teacher: How many sounds are there in the word trash? Think of the sounds in your head. 2 (point to 2, 3 (point to 3), or 4 (point to 4)? (signal)

Students: 4

If students answer incorrectly, repeat the word and then say the word sound by sound. Then ask how many sounds the word has.

Teacher: That's right! The word trash has 4 sounds, t-r-a-sh.

(Turn to page #87. Repeat same procedure for the word snail, s-n-ai-l, 4 sounds.)

(Turn to page #88. Repeat same procedure for the word safe, s-a-fe, 3 sounds.)

(Turn to page #89. Repeat same procedure for the word crab, c-r-a-b, 4 sounds.)

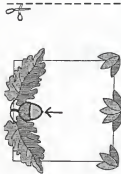
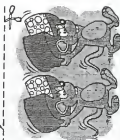
(Turn to page #90. Repeat same procedure for the word moose, m-o-o, 2 sounds.)

After you have completed this activity, lay out the game board and dice. Make sure each student has one game piece.

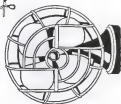
Teacher: Now we are going to play the Picture Game. Let me explain the rules of our game. The first person rolls the dice. He or she moves forward on the game board the number of spaces shown on the dice. For example, if I roll a 6, I would move forward 6 spaces. Then he/she must say the word the picture they land on shows. Next, he/she will say the word sound by sound and give the number of sounds each word has. For example, if I land on the picture of the cat, I would say "cat," "c-a-t," and "3 sounds." If

he/she says the word sound by sound correctly and gives the right number of sounds, he/she remains on the space. If he/she does not say the word sound by sound correctly and does not give the right number of sounds, he/she must go back the number of spaces they rolled. The person sitting to the right goes next. (Pick a student who has participated well in today's lesson to start the game as a reinforcement. If the students cooperate during the game, they may keep their game pieces.) Continue to play the game until time has run out for today's lesson.

APPENDIX F
REPRESENTATIVE PICTURES







APPENDIX G
REPRESENTATIVE GAME



Start

APPENDIX H
FIDELITY OF TREATMENT--OBSERVATION CHECKLIST

Date _____ Time _____ School _____

	Observed	Not Observed
Starts instruction on time.	☐	☐
Follows script.	☐	☐
Models skills accurately.	☐	☐
Signals appropriately for responses.	☐	☐
Requires response in unison.	☐	☐
Provides corrective feedback.	☐	☐
Firms group on skills.	☐	☐
Provides individual turns.	☐	☐
Provides planned reinforcement (sticker).	☐	☐
Ends on time.	☐	☐

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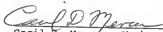
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BIOGRAPHICAL SKETCH

Penny Travis was born in Nashville, Tennessee, and grew up in Jacksonville, Florida. She graduated with a B.A. in English from Jacksonville University. After teaching high school English classes for a number of years, she moved to Gainesville where she became interested in teaching children with learning disabilities.

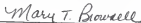
Interest in the education of children with disabilities led to the University of Florida and a master's degree in special education. Ms. Travis taught special education in public and private schools before returning to the University of Florida to work on her doctoral degree.

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Cecil D. Mercer, Chair
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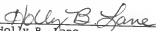
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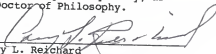
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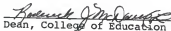
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